ASSESSING IMPLEMENTATION OF VETERINARY EXTENSION ON CONTROL OF CATTLE PARASITES, IN MORETELE DISTRICT, NORTHWEST PROVINCE

By

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Submitted in partial fulfillment of the requirements for the degree of *Magister Scientiae* (Veterinary Sciences) in the Department of Paraclinical Sciences, Faculty of Veterinary Science, University of Pretoria

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DEDICATION

I genuinely dedicate the success of this research study to the Divine for regulating me to live and become a believing scholar.

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SUMMARY

Title:

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Key words:

Veterinary extension, cattle ticks, cattle worms, parasites, State Veterinary Service, South Africa.

Abstract:

There is currently no independent monitoring and evaluation structure for state agricultural or veterinary services to support the “Batho Pele” principle of effective and efficient service delivery to the people of South Africa.

Participatory rural appraisal was used in Moretele District, North West Province, to design, implement and assess veterinary extension on the tick and worm parasites of cattle.

Veterinary extension, in contrast to agricultural extension, is defined as practical and understandable advice given to individual, groups, communities and population about livestock diseases and includes their prevention, treatment and control, as well as the way they influence the well being, health, and productivity of both humans and animals.

The study was conducted in Moretele, which lies about 60km north of Pretoria, and is divided into three service delivery wards, each managed by an animal health technician. A random sample of 30 beef cattle farmers, each with a minimum of 10 cattle, was done in each ward. From each of these 90 farmers, five indicator cattle were purposively selected to include two calves, two sub-adults and one adult animal. Adult feeding ticks were sampled from predetermined sites and eggs per gram were estimated from pooled faecal samples of the same animals.

The knowledge levels of animal health technicians (N=44) were assessed prior to the extension being given to the farmers and it was found to be inadequate. They were then given further training. Demographics and knowledge level of farmers were assessed using structured interviews.

Baseline sampling for parasites was done on the indicator cattle. A farmer's day and monthly extension using the visit and training method of extension was done with the farmers over a period of 12 months. The level of knowledge of the

farmers was reassessed and the indicator cattle resampled at the same time of the year as the first sampling.

It was found that although there was a significant increase in the farmers knowledge, there were no significant differences in the level or species of parasites. It was concluded that animal health technicians did not normally have sufficient knowledge of the subject to give farmers affective extension messages. It was also concluded that knowledge and implementation of extension are not the same thing and that further research is required into the reasons for lack of implementation.

DECLARATION

I, *Malesela James Sekokotla,* hereby declare that the work on which this dissertation is based is original and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other University.

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SIGNATURE **DATE**

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CHAPTER 1

INTRODUCTION

1. Motivation

Casey and Maree (1993) have asserted that:

"Livestock production in today's world has emerged from a rural occupation to a highly specialized industry; as social and economic reforms progress, a transition from subsistence to commercial agriculture will gain momentum; small uneconomic units will be consolidated into viable units by virtue of market forces, if not by government policies; the planning of animal production systems to achieve optimum returns, requires a full understanding of the biological principles influencing animal production efficiency, and the associated human interests and expectations."

Bath *et al.* (2001) felt that animal production should be enhanced in all suitable marginal lands in an attempt to cover the envisaged food deficiency of the country. This author also asserted that the South African Government is greatly concerned about the status of livestock health, particularly those livestock belonging to resource-poor livestock producers. In November 2001, the South African National Department of Agriculture released a Strategic Plan for South African Agriculture (www.nda.agric.co.za). As a first step to move the strategic

plan closer to implementation, the strategic partners identified the following as priority programs and actions:

- " *Fast tracking the programme of land redistribution for agricultural development and processes of empowerment for targeted groups* "
- *"Transforming agricultural research, transfer of technology, education and extension to be more responsive to markets"*

The above agrees with the statement by Casey and Maree (1993) that the main goal of agricultural development should be to increase sustainable farming productivity and welfare of the farming communities and stakeholders. However, resource-poor farmers living in marginal areas are faced with conditions that are unsuitable for improvement. Such conditions include unfavourable soils and climate, lack of credit facilities, under-developed or non-existent markets for inputs and agricultural products, weak or incipient farmers' organizations, irrelevant research and subsequent lack of adoption of relevant available technologies. The same authors have said that in the past, research has been traditionally carried out in controlled environments that were completely different from those of the users. The results were then given to the farmers for implementation. The research organizations were neither directly responsive nor accountable to the farmers.

There is an increasing need for consideration of the entire farming system, more involvement of the farmers in the problem identification and testing of the new technology (Bembridge, 1990).

According to Francis *et al.,* (2001) the rate of adoption of livestock-related technologies in small crop-livestock systems worldwide is consistently low. In order to solve this problem, approaches that guarantee effective linkages among researchers, extension workers, decision-makers, and farmers have to be invented. This strategy would empower farmers so that they could select and adapt technologies most appropriate to their agro-ecological and socio-economic environments. In order to address these problems and to make research more relevant, farmers must participate in all attempts of overcoming problems related to farming (Chambers *et al., 1993*).

The South African Department of Agriculture implements extension campaigns for farmers throughout South Africa. State employees' use varied extension methods to presumably impart knowledge and skills to farmers on various aspects of farming. There has been no proper monitoring and evaluation of the effectiveness of agricultural extension services to date. This has been recognised and according to the National Strategic Plan for Agriculture in South Africa (published on the 27th November 2001) the following has been envisaged:

" The vision of a united and prosperous agricultural sector requires partners to have action plans, key performance indicators, service delivery standards,

monitoring and evaluation systems and time frames in order to realize the aims of the strategic sector plan."

There is however no independent monitoring and evaluating structure for state agricultural or veterinary extension services, which supports the state in its endeavours to render effective and efficient service delivery to the people of South Africa.

State agricultural and veterinary extension service delivery in general, has considerable expenses, such as purchase and maintenance of subsidized vehicles, salaries of personnel, extension equipment and materials, staff refresher courses, etc. The important question is, ‘are all these expenses by the state regarding the rendering of agricultural education and skills training to farmers justifiable in terms of productivity resulting from the implementation of rendered extension?’ This is a very important area in the whole process of agricultural extension service delivery (Duvel, 2002). It applies, as well, to veterinary extension.

State agricultural extension service delivery is a resource-base for community development. Any community development endeavor should be based on participation by the community. Janoff and Weisbord (1995) assert that:

"In future search, people have a chance to take ownership of their past, present, and future, confirm their mutual values, and commit to action plans grounded in reality."

Botha *et al.* (2000) reported the following in their research regarding implications for veterinary training and research at Moretele:

- *"That there is a demand by farmers for visual and written extension material;*
- *That farmers wanted extension training to be conducted using their own herds;*
- *That there were infrastructure limitations in conducting extension and that this problem be addressed by the stakeholders collectively;*
- *That cattle and poultry were the most important animal species and should be the focus points of extension, but the need to curb zoonotic diseases should not be disregarded."*

2. Hypothesis

Moretele cattle farmers do not have sufficient knowledge and skills to control ticks and internal worms in cattle and this could be improved by an effective state veterinary extension service delivery campaign.

3. Benefits arising from the research

3.1 State agricultural extension planning will be improved because:

- Information will be gathered from state veterinary extension personnel regarding their knowledge about cattle ticks and internal worm control. This information will assist in the planning of education and skills training for state veterinary extension personnel;
- Information will be gathered from livestock farmers and this information will be useful in assessing the effectiveness of service delivery by the state veterinary personnel and it will also evaluate implementation of extension by farmers, and
- Knowledge will be acquired on constraints associated with the state veterinary extension service delivery.

3.2 State veterinary extension will be improved in general because:

- state veterinary extension workers will do less farm visits for purposes of imparting extension to farmers and would spend time monitoring extension adoption by farmers and assessing farmers' extension implementation.

CHAPTER 2

LITERATURE REVIEW

2.1. Agricultural Extension

2.1.1. Some definitions of Agricultural Extension

The United Nations Food and Agricultural Organization has defined Agricultural Extension as *"an on-going process of getting useful information to the people and then assisting those people to acquire the necessary knowledge, skills and attitude to utilize effectively this information or technology to build a better life for themselves, their families and their communities"* (Northwest Province Agricultural Extension Summit Report, 1997).

According to the Northwest Province Agricultural Extension Summit Report (1997), the United States Department of Agriculture has described Agricultural Extension as *" the sources of research-based, unbiased information and expertise that links higher education with the people who are not on campus. The extension educators/agents encourage the application of research-generated knowledge and leadership techniques to individuals, families and communities."*

The North West Province Agriculture Extension Summit delegates (1997) summed-up Agricultural Extension as *" a coordinated and co-operative exercise and service, which is aimed to help people improve their lives through an*

educational process, using scientific knowledge, focused on issues and needs as perceived or felt by them."

Bembridge (1991) defined Agricultural Extension as *"a system of non-formal education for adults in rural areas, which is based on relevant content derived from agricultural, social and communication research synthesized into a body of concepts, principles and operational procedures"*.

Agricultural extension could also be defined as a process of gathering farmers extension needs through organized participatory research, planning an extension program with the farmers for a defined period, procuring relevant resources, implementing the program using the relevant extension methods under constant and effective monitoring that is unbiased, and measuring the impact using the right mechanisms.

2.1.2. Some definitions of Veterinary Extension

McCrindle (1995) has defined Veterinary Extension as *"practical and understandable advice given to individuals, groups, communities or populations about livestock diseases, and includes their prevention, treatment and ways in which they influence the well being, health and productivity of both humans and animals".*

Veterinary Extension could also be defined as imparting relevant, practical, and focused elementary veterinary knowledge and skills to farmers and other members of the communities (upon consulting and agreeing with them on the extension program), so that at the end of a specific extension period they shall have learned knowledge and skills in a manner that can be measured.

Veterinary Extension (VE) is part of the overall Agricultural Extension (AE) and almost all of the main principles that apply to Agricultural Extension apply to Veterinary Extension.

2.1.3. Cardinal principles of Agricultural Extension service delivery

The Northwest Province Agricultural Extension Summit Report (1997) described the cardinal principles of extension as follows:

- Extension campaigns must be based on conditions that exist (local, regional and national);
- Extension workers must involve the people in actions that promote their welfare;
- They must aim basically at people's interests and needs using democratic methods;
- They should keep programs flexible;
- They should work through understanding of culture;
- They should use local leaders;
- They should use existing agencies;

- They should use trained specialists;
- They should work with all members of the family and not just the animal owner;
- They should make programs as broad as the needs of the people;
- They should continually evaluate the effectiveness of extension;
- They should keep in line with national policies;
- They should use a community approach, and
- They should help people recognize their needs.

2.1.4. Prerequisites to effective Agricultural Extension

Bembrige (1991) and Duvel (1980, 1999 & 2002) stated the following as major prerequisites for an effective and efficient agricultural extension service:

- Collective extension needs assessment of stakeholders for a set period;
- Co-operation of stakeholders in collective planning of extension activities;
- Effective and efficient implementation of plans;
- Effective co-ordination of extension activities; and
- Effective and efficient monitoring and evaluation of all extension activities by knowledgeable and unbiased people.

2.1.5. Some reasons for the failure of Agricultural Extension service delivery

The Farmer Support Service Working Group (1998) and Benor *et al.,* (1984) have cited the following as some of the reasons for Agricultural Extension failure:

- The heterogeneity of farmers being served;
- The lack of effective communication between senior and junior extension workers;
- Extension educators who have very different backgrounds;
- The urban or non-farming backgrounds of extension educators (they can therefore only advise and cannot "do");
- The fact that for many staff, a job with agriculture was not the first choice but was more the result of the lack of alternative job opportunities;
- Inadequate training of extension educators serving farmers (staff were trained in situations that were frequently academically weak and which tended to discredit local and traditional knowledge);
- Lack of clear vision and mission by state personnel;
- Lack of transport to do ”field work” by state employees;
- The poor state of offices that demoralizes and demotivate extension educators;
- Insufficient fund allocation to extension budgets, under-spending and appropriation of funds initially intended for Agricultural Extension to other activities that receive priority over extension, etc.

2.1.6. Methods of Agricultural Extension

There are many agricultural extension methods that could be used for educating farmers (most of whom are adults) in different situations. Examples are:

- The Farming Systems Research and Extension (FSR-E) method (Adams, 1982; Bembridge, 1991; Benor *et al*. 1984; Mollen and Antipas, 1999; Chuma *et al.,* 1996; Clark, 1985; Russel, 1985; Subair, 1994; Thabethe, 1996; Hawkins and van den Ban, 1996),
- Farmer-led and Farmer-to-Farmer Extension Methods (Francis and Sibanda 2001).
- Visit and training system (McCrindle *et al*, 1996**)**.

Knowledge of adult education is essential for extension practioners (Bembrige, 1991; Brundage & Mackeracher, 1980; Jacobsen, 1984; Jensen, 1960; Jensen *et a*l., 1964; Moss, 1983).

Fig 2.1: Use of the SMCRE method, using an extension campaign on rabies as an example

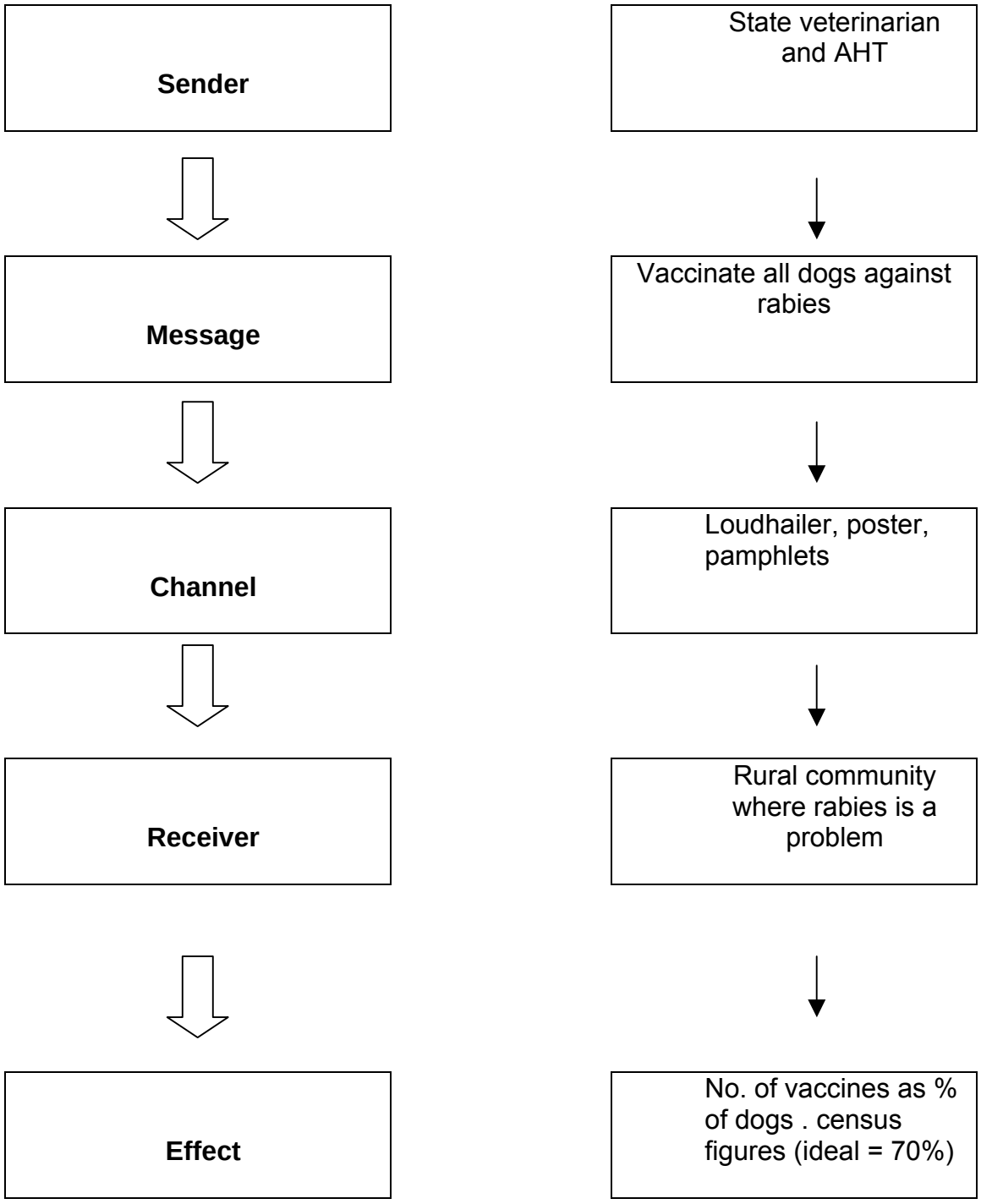


Fig. 2.1 shows the extension process Sender-Message-Channel-Receiver-Effect evaluation (SMCRE) as described by Bembrige (1991). From Fig. 2.1 the following are processes of an extension session:

- Sender: The person or organization sending the message.
- Message: The extension message. It should be short and easy to use as well as measurable.
- Channel: The way in which the message reaches the target audience or receiver e.g. farm visits, radio, TV, farmers' days, pamphlets, news media and etc.
- Receiver: The target audience. Their socio-economic and cultural circumstances must be characterized as well as language, age, interests, education and etc.
- Effects: Does the message result in the desired effect? This is how extension is measured.

2.1.6.1 Farming systems research-extension

Buttler and Buttler (1987) asserted that the FSR-E method aims to increase farm productivity in ways that are useful and acceptable to the members of the local community and focuses on the individual family goals in farming as well as the inter-relationships of goals and resources.

Farmers are often reluctant to engage in innovations because they perceive it as highly risky (Berdegue 1992). Therefore it may be necessary to asses the

perceptions of the farmers or farming community using techniques derived from social sciences. In other words, success depends on collaboration between different disciplines such as agriculturists, social scientist and veterinarians (Forno, 1999; Sigman & Swanson, 1984).

2.1.6.2 Participatory approach

Kiwanuka *et al.,* (1995) used a "participatory research and extension method" (PRE-M) to determine the methods that farmers were using to control ticks on their cattle in Odi district of the Northwest Province, South Africa. He and his co-workers found that visual counting of adult feeding ticks was the preferred method of evaluating tick burdens and it was also established that hand brush tick grease application, dip pour-on, and dip hand spraying were the preferred dip application methods for acaracides controlling cattle ticks by farmers.

Matiwane (2002) stated that*, "...Extension has to show farmers the potential of their area through conducting on – farm trials as well as training them."* The same author asserted that respondents in his research study were not impressed with the quality of extension imparted to them and thus not too keen to implement extension.

Roling (1992) suggested that extension is important if it helps the farmers to get organized and be able to communicate, this facilitates action planning and a joint approach, involving all stakeholders.

Hawkins and Van den Ban (1996) felt it was important for farmers to participate in planning of agricultural extension programs, due to the fact that farmers have information that is imperative in the planning of extension programs, and that farmers were more likely to cooperate in the implementation of an extension programme if they are co-planners of such programs. This has been supported by other researchers in Agricultural Extension such as Chambers *et al.,* 1993.

Heinrich *et al.*, (1991) gave a classical example of the benefits arising from farmers' involvement in research on farms in Botswana, where the primary research emphasis on descriptive and diagnostic activities went on to include the design and testing activities. The farmers themselves were able to record much of the data.

Hűttner and Wanda (1996) asserted that in order to gain sufficient knowledge of the production parameters and calf mortality patterns in cattle herds, an on-farm survey is imperative, since the information thus gathered will help in the design of better extension messages with participation of the farmers..

Biggs *et al.,* (1991) affirmed that institutional innovations and strong policy commitment are needed if on-farm research is to succeed in meeting the needs of resource-poor farmers. Sound research methods alone are often not sufficient.

Seobi (1993) mentioned that although the group approach has always been recognized as an appropriate method for the development of subsistence and emerging farmers, this approach has also been applied unsuccessfully when strategies applied were not relevant and appropriate to the farmers needs. He suggested that there is a need to review strategies and apply appropriate methods for fostering group - formation and participation among small-scale farmers. This author warned that this process requires the involvement of trained and skilled extension workers as well as trained group members.

2.2. Cattle ticks and tick-borne diseases

2.2.1. Introduction

Ticks are important external parasites of cattle (Fivaz and Spickett, 1992). The geographic distribution of cattle ticks in South Africa, the diseases they cause, host susceptibility to tick borne diseases, diagnosis of tick born diseases, control of cattle ticks, and the socio-economic of cattle ticks control will be reviewed in this section.

Ticks and tick-borne diseases are of considerable economic significance in South Africa (Bigalke, 1980). The following disorders are associated with tick infestation: blood loss, decreased weight gain; damage to hides, teats, udders, prepuce, testes, and ears; toxicity such as sweating sickness, and transmission of tick-borne diseases (Taylor and Plumb, 1981).

2.2.2. Distribution of cattle ticks in South Africa

Different species of ticks are found in different geographical areas in South Africa. The type of vegetation, humidity and temperature influences their distribution. The distribution of the main cattle ticks is shown in Table 2. 1 below.

Table 2. 1. Distribution of cattle ticks in South Africa (Jordaan, 1994)

Common tick name	Scientific tick name	Geographical distribution
African blue tick	*Boophilus decolaratus*	Mpumalanga, Limpopo, Gauteng, and Northwest Province, Swaziland, Kwazulu-Natal, Northern and Eastern Free State, Eastern Cape, Coastal strip of Southern and Southwestern Cape.
Pantropical blue tick	*Boophilus microplus*	Small localized patches in Gauteng and Eastern Mpumalanga, Coastal Kwazulu - Natal, Eastern and Southern Cape coast.
Bont tick	*Amblyomma hebraeum*	Eastern Limpopop and Mpumalanga; Coastal Kwazulu - Natal; Eastern, Southern & Southwestern Cape.
Large bont-legged tick	*Hyalomma marginatum rufipes*	Karoo.
Small bont-legged tick	*Hyalomma truncatum*	Southern Africa except coastal Eastern Cape, Kwazulu Natal, and Eastern half of Free State.
Brown-ear tick	*Rhipicephalus appendiculatus*	Southeastern Limpopo, North Eastern Mpumalanga, Coastal Kwazulu - Natal, Eastern, Southern, and Southwestern Cape province.
Red-legged tick	*Rhipicephalus evertsi evertsi*	Eastern half of Southern Africa, South-western Cape province coastal areas

From Table 2. 1 it is clear that the distribution of tick species differs from area to area. It is thus imperative for farmers to know which tick species and tick-borne

diseases occur in their particular area. This will help in the control of the tick-borne diseases and disorders in a particular cattle-farming area.

All species mentioned in Table 2.1 are found in Moretele area of Northwest Province except for *Hyalomma marginatum rufipes* (Spickett, 1999-2000).

2.2.3. Short notes about cattle tick species found in Moretele

2.2.3.1 *Boophilus* spp

Boophilus decoloratus (African Blue Tick) and *B. microplus (*Pantropic Blue Tick):

- *B. decoloratus* was found throughout Moretele. This species only transmits *B. bigemina but,* like *B. microplus* it transmits both of the protozoa causing anaplasmosis in cattle (Walker, 1994).
- *Boophilus microplus (*Pantropic Blue Tick) was found on the farm Boschplaas 91 and Legkraal 54 (Spickett, 1999-2000). It is smaller than *Boophilus decoloratus* (African Blue Tick). It transmits both *Babesia bovis* and *B. bigemina* protozoa to cattle but more frequently transmits *Babesia bovis* (Asiatic Redwater) than *B. bigemina* (African Redwater). It also transmits both the rickettsias *Anaplasmosis marginale* and *A. centrale* in cattle (Walker, 1994).

These two species of ticks are mainly found on cattle although small numbers may be found on other livestock such as horses, sheep, and wild ruminants

(Walker, 1994). Both ticks are one-host ticks and they are active throughout the year (Londt *et al.*, 1979).

2.2.3.2 *Hyalomma truncatum* and *Hyalomma marginatum* (Bont-legged ticks):

These tick species feed on a variety of mammals including cattle, sheep and goats and can assume a one-host, two-host or a three-host life - cycle depending on the species of the host (Walker, 1994). The adults show a summer peak between October and March (Londt *et al.*, 1979). The saliva of *H. truncatum* causes toxic effect in livestock, namely the disease called sweating sickness and tick paralysis (Walker, 1994).

2.2.3.3 *Amblyomma hebraeum* (Bont tick):

This tick is flat, hard, and colourful (Spickett, 1999-2000). It is a three-host tick that feeds on a wide range of mammals including cattle, sheep, goats, birds, reptiles, and sometimes amphibians (Walker, 1994). A. *hebraeum* transmits the rickettsia organisms *Cowdria ruminantium* and *Theileria mutans* to cattle (Walker, 1994). In South Africa, adult activity of this tick starts at the beginning of September and declines towards the end of January (Baker and Ducasse, 1967). Despite transmitting the heartwater - causing infectious agent, heavy infestations also lead to production losses due to teat and udder damage (Asselsbergs and Lopes-Pereira, 1989). This may result in poor milk production and retardation of calf growth.

2.2.3.4 *Rhipicephalus evertsi evertsi* (Red legged tick):

This two–host tick was found throughout Moretele with adults reaching their activity peak between January and the end of May (Spickett, 1999-2000). It transmits *B. bigemina*, *A. marginale*, and *Borrelia theileri* (spirochaetosis of cattle and horses) (Rechav *et al.*, 1977).

2.23.5 *Rhipicephalus appendiculatus* (Brown ear tick):

This three–host tick was found throughout Moretele with adult activity rising sharply in November and reaching a peak in January to February (Spickett, 1999-2000). According to Walker (1994), this tick species transmits *Theileria parva parva*, *Theileria taurotragi* and the *Ehrlichia* species of rickettsiae. Heavy ear infestation causes wounds that become infested with screwworm (a larval stage of the *Chrysomya* fly) (Walker 1994).

2.2.4. Control of cattle ticks

2.2.4.1. Introduction

The control of ticks and tick-borne diseases is considered as the most important animal health and management problem in Africa. This problem is increased by the occurrence of large populations of wild ungulates maintaining both tick vectors and tick-borne diseases (Grootenhuis and Young, 1981 and 1985).

In the formulation of tick control strategies, it is important to bear in mind that wild animals are also important hosts for the ticks found on domestic cattle (Bryson,

2000; De Klerk *et al*, 1984). The mixed bush-veld area found in Moretele district is an ideal habitat for cattle ticks (Acocks, 1975; Taiton, 1981).

It is important to know the life cycles of the different genera of ticks (e.g. a one host tick life-cycle, a two host tick life-cycle, and a three host tick life-cycle) in order to effectively implement tick control strategies (Fivaz *et al*., 1999; Sutherst, 1981; UNFAO, 1984; Shaw *et al.*, 1989).

It is also important to know the seasonal abundance of ticks in order to control them optimally. Tice (1995) affirmed that it is easier to arrive at conclusions on the seasonality of tick burdens in cattle, than to give a quantitative assessment of the level of tick infestation. In general *B. decoloratus* and *B. microplus* were found to peak in spring and autumn (Norval, 1977) in some areas while in other areas they were found throughout the year (Londt *et al.*, 1979; Rechav, 1982*). Hyalomma marginatum rufipes* and *H. truncatum* have been found to be present in summer and absent in winter (Londt *et al.*, 1979; Norval, 1977; Schroder, 1980)*. R. appendiculatus* shows a definite seasonal pattern of abundance in the Southern African region, with larvae most active in the autumn, nymphae in spring and adults in summer (Londt *et al.*, 1979; Schroder, 1980). *R. evertsi* adults occur throughout the year with a peak in summer (Londt *et al.*, 1979; Norval, 1977; Rechav, 1982; Schroder, 1980).

2.2.4.2. The various methods of controlling cattle ticks

Breeding tick resistant cattle:

According to Knott (1983), cattle could be genetically selected for tick resistance, especially those from endemic areas. Bonsma (1944) asserted that the Afrikaner cattle and their crosses naturally show lower heartwater mortality than the exotic beef breeds. This author suggested that in order to enhance effective tick control using this method, it is desirable to have 50% *Bos indicus* infusion and to cull 15-20% of susceptible progeny in the F1 generation. Bock *et al*. (1997) maintained that *Bos indicus* breeds of cattle had innate resistance to infection with *Babesia bovis*, *B. bigemina*, and *Anaplasma marginale* as compared to *Bos taurus* breeds.

Pasture management:

- Pasture spelling

In this method, pastures are kept free of cattle until the ticks die of hunger, but in most cases it is impractical to keep animals from occupying a paddock for long enough to allow all stages of the tick to die of starvation (Chiera *et al*, 1984; Dolan *et al*, 1983).

- Pasture burning

Pasture burning, as a method of controlling ticks is general practiced in East Africa. This is done once a year, both to improve the pasture and to control tick populations. This method is not an effective method of tick control, since many

stages of tick development miss the effect of veld burning due to the fact that during the usual veld burning time they are in the soil and recolonize burnt areas (Branagan, 1970).

- Veld improvement

Certain grasses and legumes (*Cassia absus, Stylosanthes* and *Melinis minutiflora*) were shown to kill cattle ticks and hence would inhibit their ascent up the vegetation (Jones *et al,* 1982). Sutherst (1983) also pointed out that improvement of the nutrient value of pasture would allow cattle to develop a better resistance to tick infestation. The effect of this has not been measured, however, little pasture improvement has occurred in many areas of Africa (Groocock *et al.*, 1988).

Chemical tick control methods:

Fivaz and Spickett (1992) gave examples of chemicals used to control ticks as follows:

- Organophosphates
- Carbamates
- Chlorinated hydrocarbons
- Synthetic pyrethroids
- Formamides
- Microcyclic lactones

Table 2.2 shows some arcaricides that could be used to control ticks on cattle.

Table 2. 2. Arcaricides that could be used to control ticks on cattle (Swan, 2003)

Trade name	Reg. no	Active ingredients	Company
1. Organophosphors and carbamates			
Disnis NF Dip	G1015	Chlorfenvinphos 9%	Bayer
Karbadip Spray	G1291	Carbaryl 50%	Bayer
Supona 30 cattle dip	G1284	Chlorfenvinphos 30%	Fort Dodge
Zipdip	G381	Triazophos 40%	Intervet
2. Pyrethrins and pyrethroids			
Bayticol Liquid	G489	Flumethrin 2%	Bayer
Paracide	G791	Alphamethrine 7%	Pfizer
Delete Pour-on	G2815	Deltamethrine 0,5%	Intervet
Tick Grease	G1104	Cypermethrin 0,025%	Bayer
3. Formamidines			
Amidip 200 Liquid	G2601	Amitraz 20%	Virbac
Qualitraz 250	G2512	Amitraz 25%	Janssen
Triatix WP cattle spray	G850	Amitraz 23,75	Intervet
4. Macrocyclic lactones			
Cevamec	G2811	Ivermectin 1%	Novartis
Dectomax Injection	G1726	Doromectin 1%	Fort Dodge
Ecomectin 1% Injection	G2275	Ivermectin 1%	Eco
Ivomec Pour – On for cattle	G1588	Ivermectin 0,5%	Merial
Noromectin Injection	G2734	Ivermectin 1%	Pharmacia
Virbamax LV Solution	G2785	Abamectin 0,2%	Virbac
5. Combinations			
Delete All	G2837	Amitraz 2%+Piperinyl butozide 2% + Deltamethrin 0,5%	Intervet
Ektoban	G598	Cymiazol 17,25% + Cypermethrine 2,5%	Novartis
Pouracide NF	G971	Alphamethrin 0,5% + Cypermethrin 1% + Tetrachlorvinphos 2% + Piperonyl butozide 7, 5%	Pfizer
Tikgard	G1486	Chlorfenvinphos 30% + Alphamethrine 3%	Fort Dodge

The proper combinations of arcaricides provide a broad-spectrum effect that can be used to control a wide range external parasite of cattle effectively, although there is a rapid development of resistance to these products (Spickett 2000-personal communication). According to Regassa (2000) there are certain herbal mixtures that could be used to control cattle ticks with 70% of efficacy. Control of tick infestation through the use of acaricides is one of the methods that can be used to reduce tick-borne disease such as heartwater in cattle (Fivaz and Spickett, 1992).

Endemic stability

Du Plessis *et al.,* (1992) suggested that strategic chemical control can be attained, if natural infection through low tick burdens can establish and maintain premunity that results in endemic stability. Endemic stability is defined as a situation where tick infestation is maintained, through tick control measures, to be so mild that the animals are exposed to sufficiently low doses of disease agent that they develop adequate immunity without developing the diseases (Spickett 2000-personal communication).

Bryson (2000) and Tice (1995) have found that, in order to attain endemic stability of cattle tick-borne disorders in a given area, one has to dip cattle only when the visible adult feeding ticks exceed twenty (20) on any one animal in a herd. They asserted that the presence of more than 20 feeding adult ticks are

likely to cause the development of disorders such as tick-borne diseases, skin abscesses, ear bleeding and mastitis.

Du Plessis *et al.* (1992) determined that tick burdens of ten ticks per animal throughout the year at Mara, coupled with an infection rate of 3%, was enough to maintain endemic stability to heartwater. These authors concluded that higher infection rates and lower tick burdens would also suffice to induce endemic stability.

Mahoney *et al.* (1972) and De Vos and Potgieter (1983) mentioned that cattle breed, tick control strategies, and tick climatic conditions were some of the many different factors, which could affect endemic stability to tick-borne-diseases (TBD). The degree of endemic stability for *A. marginale* has not been statistically correlated to dipping strategy (Biggs and Langenhoven, 1984). The development of endemic stability in a herd does not mean that the individual animals are 100% immune to tick-borne diseases and as such few sporadic clinical cases of TBD could still be encountered (Camus and Uilenberg, 1993). Pegram *et al.* (1986) suggested that tick population sampling is vital in the assessment of endemic stability in any communally grazed area. Endemic stability is an important concept in tick control and the state veterinary extension staff must understand it themselves so that they can effectively impart that knowledge to cattle farmers.

Vaccination as a means to control ticks:

Vaccination can also be considered as a method of tick control, e.g. cattle can be vaccinated against the tick *B. microplus* by inducing an immunologic reaction against the antigen (Bm 86 Ag) in the tick gut (Groocock *et al.,* 1988; Rechav and Tembo, 1992; Willardsen *et al.*, 1989). The uptake of the antibody during the subsequent tick feeding leads to severe damage to the parasite. Currently this method is not general use for tick control.

Summation of control methods

The most cost-effective methods for cattle ectoparasite control are strategic application of acaricides methods that results in the maintenance of an endemic stability. Animal health technicians and extension workers should use this concept when designing extension messages for farmers. In order to develop this knowledge, the following two basic concepts must be understood:

- Recognition of adult tick species so that the cattle farmer can count the ticks required to maintain endemic stability (10-20 of each species per animal).
- Knowledge of the types of acaricides available on the market and their correct usage.

These concepts were incorporated into a structured interview questionnaire to evaluate the knowledge of cattle farmers that participated in this study (see appendices 1, 2, and 3).

2.2.4.3. Sampling of ticks to improve proper tick control

Sampling of ticks is important in that it helps determine the type of ticks that occur in a given herd, and thus the type of control measures to be employed. Various workers have critically analyzed live tick sampling methods (Schroder, 1980). According to Londt *et al.* (1979), one may sample known predilection sites as descubed by Baker and Ducasse (1967). It is important to bear in mind that ticks are 'over dispersed' on the cattle (Spickett *et al.*, 1990) and on the vegetation (Rechav, 1982), and the result is that the samples are often unrepresentative of the population, even if the sampling units are randomized (Tice, 1995). Tice (1995) asserted that the removal of feeding adult ticks during sampling should be done carefully with a forceps from various sites on the cattle to avoid crushing, and ticks placed into a bottle of 70% ethanol. Site and animal specifications should be correctly made on the specimen bottles before returning the samples to the laboratory for tick identification under a stereoscopic microscope.

According to Spickett (2000-personal communication) it is worth calculating the percentage of each adult tick species in the visual count because this information is helpful in determining the occurrence or likelihood of a particular tick-borne disease in a given area.

It is important to note that sharing of handling facilities such as crush pens, enhances the spreading of *B. microplus* into new grazing areas, and this fact

must be taken into account when sampling and assessing tick burdens of communal herds (Wedderburn *et al.*, 1991). This may also apply to other tick species.

2.2.5.Control of tick-borne diseases of cattle

2.2.5.1 Introduction

Different tick species transmit different diseases. Sometimes the same tick can transmit more than one cattle disease e.g. the African blue tick transmits both redwater and anaplasmosis. According to Bryson (2000), the infection rate of ticks to disease causing agents varies from area to area, developmental stages of the ticks and between males and female ticks. The proper control of cattle ticks results in the enhancement of tick-borne disease control. Table 2.3 shows cattle ticks and the diseases associated with them.

Tick-borne diseases are well described by Berold and Caine (1981), Blood *et al.* (1983), Coetzer *et al. (*1994), and Turton, (1999). Hurter (1981) and Shaw *et al.,* (1989) state that control of tick diseases is optimally attained by:

- implementing a proper tick control program for a given herd of a specific place,
- treating sick animals, and
- vaccinating cattle against Anaplasmosis, Babesiosis and Heartwater in endemic areas (especially cattle which are from non-endemic areas).

Table 2.3 Cattle ticks and the disease(s)/disorder(s) associated with them (Combrink *et al.*, 1998; De Castro, 1995; Jordaan, 1994; Shaw *et al.*, 1989; Monnig and Veldman, 1981; Horak *et al.*, 1987; Howell *et al.*, 1978).

Tick species	Causative agent	Disease/ disorder	Symptoms
Boophilus decolaratus (African blue tick)	*Babesia bigemina*	Redwater	Fever, loss of appetite, red urine, anaemia, jaundice, and death.
Boophilus microplus (Pantropical blue tick)	*Babesia bovis*	Redwater	As above but nervous sings may be seen.
Amblyomma hebraeum (Bont tick)	*Cowdria ruminantium*	Heartwater	Fever, nervous symptoms, diarrhoea, and death.
Boophilus decoloratus (African blue tick)	*Anaplasma marginale and centrale*	Anaplasmosis	Fever, constipation, jaundice, and death.
Rhipicephalus appendiculatus (Brown- ear tick)	*Theileria lawrencei*	Corridor disease	Fever, anorexia, swelling of the retropharyngeal lymph nodes, difficult breathing, coughing, tar-like diarrhoea & death.
Rhipicephalus appendiculatus and Rhipicephalus evertsi evertsi (Red- legged tick)	*Theileria parva parva*	East coast fever	Same as for corridor disease.
Hyalomma truncatum (Bont –legged tick)	Toxin	Sweating sickness	Fever, moist eczema of calves' skin (with skin epidermis removable), anorexia, emaciation; dehydration, and death.

Intergrated tick and tick-borne disease control based on endemic stability is a better method if the level of natural exposure to tick-borne disease in cattle population as well as the distribution of these diseases are determined (Bock *et al.*, 1999).

2.2.5.2 Susceptibility of cattle to tick infestation and to tick – borne diseases

Some animals are more heavily infested with ticks than others and some animals are more susceptible to tick-borne diseases than others. It is assumed that this

difference is due to a better natural immunity in the less infested animals (and Coetzer *et al.* 1994 and Shaw *et al.* 1989).

Calves born to cows that are not immune to heartwater, are very susceptible to heartwater disease and the mortalities are usually high (Du Plessis *et al.*, 1988). According to Monnig and Veldman (1981) climatic conditions, the type of vegetation, age, malnutrition and worm infestation increase the susceptibility of calves to sweating sickness.

Tice *et al.* (1998) found that cattle grazing on communal land showed the absence of clinical disease where farmers changed from an intensive dipping programme to one of endemic stability to tick – borne diseases. According to Camus and Uilenberg (1993) calves have an inherited age-linked resistance to bovine babesiosis and anaplasmosis, which is independent of the immune status of the dam, and may last nine months or longer. A state of endemic stability to tick – borne diseases (TBD) is possible if there is sufficient infection rate to ensure that all calves develop effective acquired immunity before the natural immunity wanes.

2.2.6. Diagnosis of tick – borne diseases

The veterinarians' diagnosis of tick borne diseases rests on clinical signs, tissue or blood samples, epidemiology and necropsy (Coetzer *et al*, 1994). As many parameters are required for the diagnosis of tick-borne diseases farmers should

rather be expected to understand the basic clinical picture, elementary treatment, and prevention through tick control and leave diagnosis to veterinarians. It appears from veterinary needs appraisals done in Moretele and the nearby Odi district (Botha *et al.,* 2000, McCrindle *et al.,* 1994, and Stewart, 1997) that owners of animals do not get adequate veterinary extension on tick control and tick recognition and the information they get cannot be used effectively.

2.2.7 Resistance of ticks to acaricides

Resistance has been defined as "the ability of tick species to develop tolerance to an acaricide dose that would prove lethal to the majority of individuals in a normal population of the same species" (Spickett, 2000 personal communication). There is overwhelming evidence that resistance to chemicals in ticks and other arthropods, is inherited and develops primarily because of the selective effect of chemicals on resistant mutants that pre-occur in low frequencies in field populations (Hoffmann *et al.*, 1995).

Stone (1972) indicated that resistance by an arthropod to a chemical may be due to one or a combination of factors such as:

- reduced penetration through the integument or other reduced uptake of the chemical;
- increased storage or excretion of the unchanged toxicant;
- reduced 'toxication' of an applied chemical, which requires conversion within the arthropod to the toxicant proper;

- increased detoxification within the arthropod body by metabolic breakdown of the penetrated toxicant before it reaches its site of action;
- reduced reactivity or 'sensitivity' to the toxicant of the vital biochemical or physiological system under attack at the site of action.

This author considered it most unlikely that resistance genes arise as a direct result of acaricidal treatment.

2.2.8 The socio-economic aspects of tick-borne diseases

Mukhebi (1992) outlined the costs of tick-borne disease as production costs, treatment of diseases costs and costs of tick control. He affirmed that there are direct and indirect production costs related to tick-borne diseases, e.g. there is a reduction in weight gain from an animal suffering from a tick-borne disease, and also the time lost in caring for a sick animal. The direct costs are all expenses associated with the treatment and vaccination of animals against tick-borne diseases. The indirect costs are those related to time and labour to care for sick animals. The African continent in general, has experienced a progressive deterioration of the quality of veterinary care, something that has contributed to the spread of tick-borne diseases. Government expenditures on tick-borne disease control are often not sufficient to eradicate these diseases, due to the weak economic standing of developing countries. Standard control measures for tick-borne diseases are losing their effectiveness through poor service delivery policies, rising costs of tick-control vaccines and remedies, and rising labour costs, as well as problems associated with drug resistance. The main constraints

to addressing the socio-economic aspects of livestock diseases are lack of good data and the absence of social scientists in veterinary departments and research institutions. He further emphasized that an interdisciplinary research approach, integrating biological and social scientists, is required in order to investigate, understand and alleviate the technical and socio-economic factors limiting livestock production. Policy makers must prioritize well because the ignorance of effective livestock disease control in a given country could lead to an economic or trade embargo by other countries resulting in adverse socioeconomic implications.

2.2.9 Developing an extension message

The SMCRE method of extension, proposed by Bembridge (1991) maintains that the message should be related to the desired effect and should be measurable. In the light of the literature reviewed, the following knowledge and skills are required if farmers are to be empowered to recognize and control ticks on their cattle:

- How to recognize the different ticks and the diseases associated with specific ticks;
- Different types of tick-borne disease treatment;
- How to read, understand and follow instruction on medicine leaflets;
- Usage of acaricides to control cattle ticks;
- Methods of acaricide application and when to use them;
- Seasonal differences in tick control;

- Safety precautions and side effects regarding the use of acaricides;
- Where to buy acaricides, and
- Proper record keeping.

It is important that the application of the knowledge and skills imparted to farmers during extension be monitored and be evaluated in an unbiased manner over a set time frame so as to assess the success or failure of the extension campaign. The effect of this extension can be measured in two ways by the knowledge gained and by the level of control of the ticks (application of knowledge)

2.3. Cattle internal worms

2.3.1. Introduction

Important internal worms of cattle are nematodes (roundworms), cestodes (tapeworms) and trematodes (flukes) (Berold and Caine, 1981; Blood *et al.*, 1983; Dunn, 1978).

Important internal worms of cattle are *Haemonchus* spp, *Trichostrongylus*_spp, *Cooperia* spp, *Oesophagustomum* spp (Horak and Louw, 1978). *Fasciola ssp*, *Paramphistomum ssp*, *Bunostomum ssp* and *Dictiocaulus ssp* may also be a problem on specific farms (Vatta and Boomker, 2000-personal communication).

Horak (2000-personal communication) suggested that a high level of internal parasites can lead to anemia, lowered feed digestion and absorption leading to a

decrease in total blood protein, resulting in emaciation and weakened resistance to diseases. He also stated that it is impractical to design a general dosing program for all areas because of the differences in farm management practices, worm types, climate, etc. The following are factors that are to be taken into consideration when designing a worm control program for cattle:

- *Ostertagia ostertagi*, *Cooperia oncophora* and *Haemonchus placei* overwinter in the host in a state of hypobiosis (Horak, 1978). The mechanism that triggers this inhibition could be environmental stimuli, such as chilling which may act on the infective larvae (Armour *et al.*, 1974, Thomas and Waller, 1975), suggested, however, that cold is not necessarily a stimulus for subsequent inhibition of *Haemonchus contortus* development. These authors suggested that it might be due to adaptation of the parasite to a particular environment in which it finds itself.
- There are seasonal changes in internal worm burdens of cattle (Horak, 1978; Reinecke, 1964).
- There is also a degree of cross-infestation that takes place between wild animals such as impala and cattle sharing the same habitat (Horak and Louw, 1978).
- Boomker (2000 – personal communication) asserted that internal worms of cattle are not a big problem in extensive cattle farming systems, except for calves in certain areas and extension messages should therefore be designed to prevent unnecessary dosing or dosing with the incorrect anthelmintics. Incorrect administration of anthelmintics can lead to

unnecessary expense to farmers, toxicity or development of resistance (Reinecke, 1989).

Horak (2000-personal communication) stated that in the subtropical summer rainfall areas of Southern Africa, cattle should be treated for internal worms 21 days after the first rain following the long dry period of winter and again when the worm burden in the animal and on the vegetation is at a peak in February.

Reinecke (1960) suggested that lack of dung pad reduction and improper animal husbandry practices are the two main factors in the transmission of the common nematodes of cattle, viz. *Haemonchus placei*, *Cooperia pectinata*, *Cooperia punctata*, *Oesophagostomum radiatum* and *Bunostomum phlebotomum.* Removal of dung pads and optimal management reduce the multiplication of cattle worm in a given farming unit.

2.3.2. Control of internal parasites of cattle

2.3.2.1. Different methods of controlling cattle internal worms

Reinecke (1989) has suggested various methods of controlling worms in cattle. These include chemical worm control (oral anthelmintic administration and anthelmintic injection), regular kraal manure removal, proper camp stocking and pasture rotation. With regard to chemical control, wide range of halogenated salicylanilide congeners (e.g. closantel, resorantel, rafoxanide, oxyclozanide, niclosamide, etc) active against helminth parasites have been developed and

registered for usage in animals Swan (1999). Table 2.4 shows the active ingredients of anthelmintics that could be used for chemical control of worms in cattle.

Table 2. 4. Active ingredients of anthelmintics for cattle (Swan , 2003).

Trade name	Active ingredients	Company
1. Benzimidazoles and probenzimidazoles		
Multispec	Mebendazole 5%	Janssen Animal Health
Panacur BS	Fenbendazole 5%	Intervet SA (Pty) Ltd
Prodose Blue	Albendazole 7.5%	Virbac RSA (Pty) Ltd
Valbazen Ultra	Albendazole 7.5%	Pfizer Animal Health
2. Macrocyclic lactones		
Cevamec	Ivermectin 1%	Novartis South Africa (Pty) Ltd
Dectomax	Doramectin 1%	Pfizer Animal Health
Ecomectin injection	Ivermectin 1%	Eco Animal Health SA (Pty) Ltd
Ivomec Pour - On	Ivermectin 0.5%	Merial South Africa (Pty) Ltd
3. Halogenated salicylanilides		
Ranide injection	Rafoxanide 3%	Virbac RSA (Pty) Ltd
Ranox	Rafoxanide 3%	Pfizer Animal Health
Trodax	Nitroxynil 34%	Merial South Africa (Pty) Ltd
4. Imidazoles		
Levicon	Levamisole HCl 25%	Bayer Animal Health Division
Prodose Red Oral	Levamisole 2,5%	Virbac RSA (Pty) Ltd
Ripercol-L Soluble Powder	Levamisole HCl 99%	Janssen Animal Health
Tramisol Concentrate	Levamisole HCl 25%	Intervet SA (Pty) Ltd
5. Combinations		
Crede-Mintic Roxilev	Levamisole 2%+ Rafoxinide 3%	Experto Vet Ltd
Leviran	Levamisole 3%+ Rafoxinide 3%	Bayer Animal Health Division
Tramisol Plus	Levamisole 2,5 % + Rafoxinide 2,5%	Intervet SA (Pty) Ltd
Tramizan	Levamisole 2,5 % + Oxyclosanide 3,5%	Intervet SA (Pty) Ltd

Anthelmintic treatment of cattle, combined with relevant dietary supplementation has also proved to be a cost – effective way to control cattle worms (Kyvsraad *et al.*, 2000).

2.3.2.2. Anthelmintics resistance

Dunn (1978) stated that, "*One form of parasite adaptation which is becoming of greater and greater economic importance is the capacity of some helminths to develop tolerance to anthelmintics*."

Cases of resistance to benzimidazoles by populations of *Trichostrongylus axei*, *Ostertagia ostertagi* and *Cooperia oncophora* have been reported in cattle in Australia and New Zealand (Hosking and Watson, 1991; Jackson *et al.,* 1987; McKenna, 1991).

Van Wyk (2001) asserts that the phenomenon of 'refugia' plays a much more important role in the selection for anthelmintic resistance than other phenomena that are more frequently investigated and has recommended methods for counteracting it. These include reduced drenching frequency and avoidance of under-dosing. This author suggested that farmers should be educated to consider refugia above all else when designing worm management programs.

2.4 Development of extension message on worms

Farmers should be given extension specific to internal worms of cattle, and the application / implementation of the learned extension knowledge in this regard must be monitored and evaluated over a set period of time (Boomker, 2000-personal communication). Considering the literature review, extension given by the state employees regarding cattle internal worms should include the following:

- how to recognize the different worms and the disorders associated with high worm burdens,
- types of anthelmintics used to control worms in cattle,
- how to read, understand and follow the instructions on stock remedies,
- when to treat cattle for internal worms and the various methods used;
- side effects of incorrect use of anthelmintics in cattle, namely toxicity and drug resistance;
- where to buy anthelmintics, and
- proper record keeping.

CHAPTER 3

MATERIALS AND METHODS

3.1. Study area

This study was conducted in the state veterinary area of Moretele in NWP, situated approximately 60 km north of Pretoria (see appendix 5). The annual rainfall of this area is +/-600mm and the temperature averages 12° C in the winter season and 25° C in summer (Botha *et al.,* 2000). The veld types are mixed bushveld, Kalahari thornveld, and springbok flats turf thornveld (Acocks, 1975; Botha *et al.,* 2000).

The state veterinary area of Moretele is divided into three service delivery wards. A qualified Animal Health Technician (AHT) manages each ward. The area is further divided into the following Field Service Delivery Units (FSDU) that are controlled by the Moretele District Agricultural Center:

- Maubane FSDU: 28° 15’ East, 25° 19’ South (Ward 2),
- Makapanstad FSDU: 28° 06’ East, 25° 14’ South (Ward 2),
- Swartdamstad FSDU: 28° 02’ East, 25° 20’ South (Ward 3),
- Syfeskuil FSDU: 28° 12’ East, 25° 05’ South (Ward 1),
- Ngobi FSDU: 28° 07’ East, 25° 03’ South (Ward 1), and
- Lebotloane FSDU: 27° 56’ East, 25° 05’ South (Ward 1).

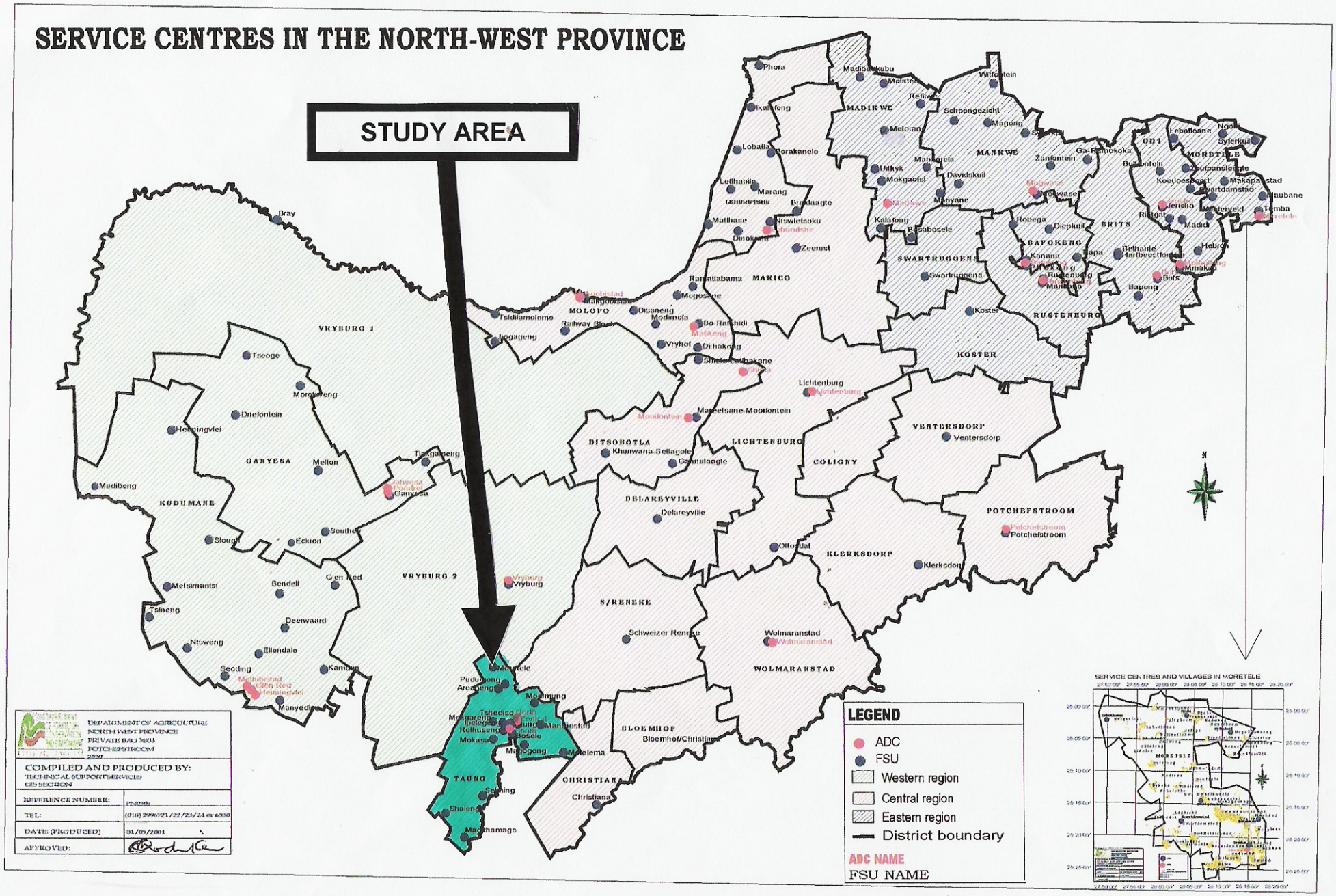


Plate 3.1 State Veterinary Districts of NWP showing study area: Moretele District

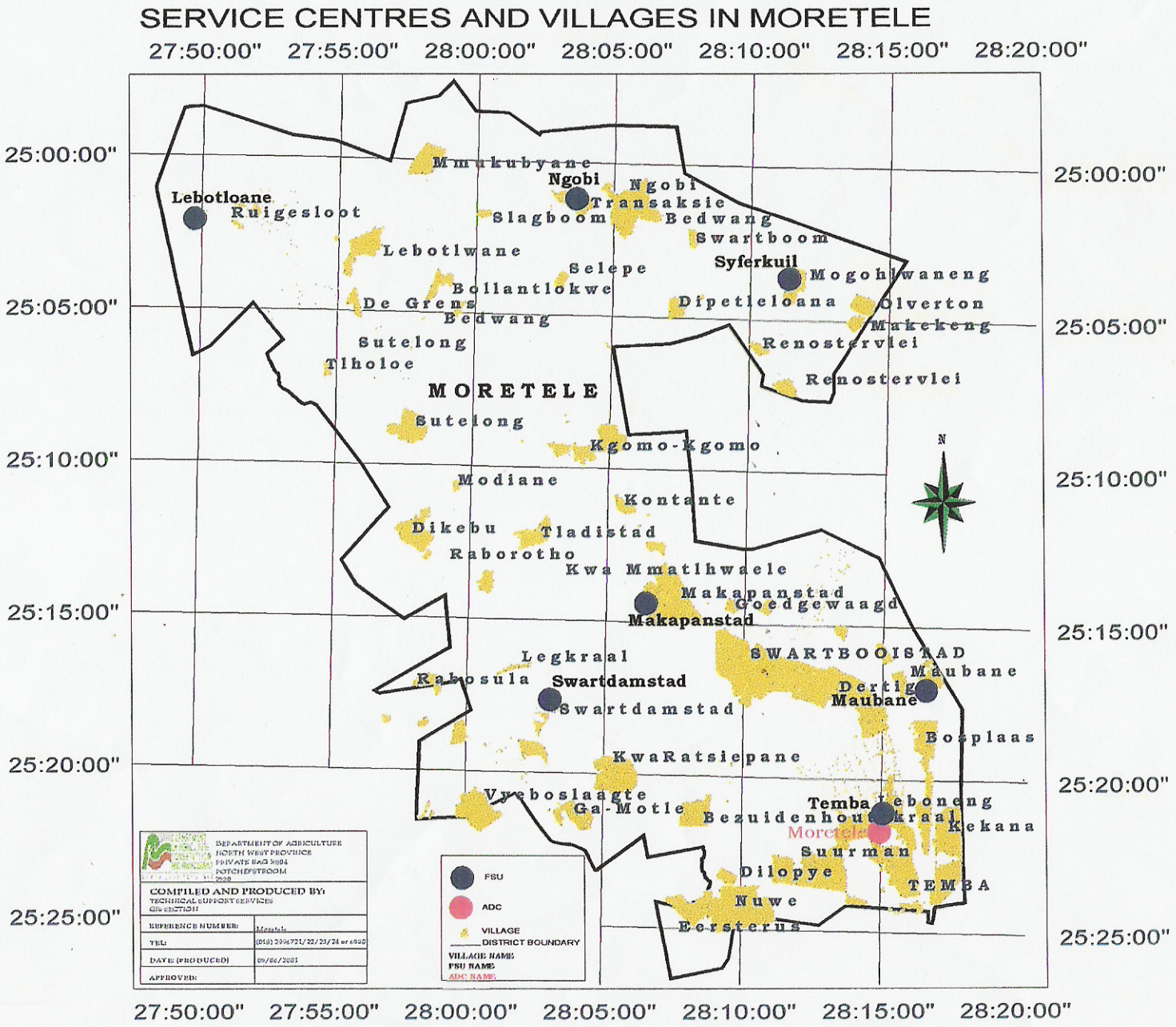


Plate 3.2 Moretele District showing wards and State Veterinary Service Centres

3.2 Sampling methods

This research was divided into the following phases:

Phase 1: Problem identification and its evaluation

- Appraisal of farmers' extension needs;
- Evaluation of knowledge of Animal Health Technicians (AHTs)
- Data obtained from farmer demographics, baseline knowledge about ticks and internal worms (March 2001 to May 2001);
- Sampling of cattle for ticks and internal worms (March 2001 to May 2001);
- Evaluation of data; and
- Development of extension messages.

Phase 2: Implementation of Extension

- Knowledge and skills training of farmers using individual farmer visit and training extension method (September 2001 to November 2001).

Phase 3: Assessment of the effect of extension

- Evaluation of farmers knowledge after workshop (same day of extension training);
- Evaluation of farmers knowledge 6 months after their workshop (March 2002 to May 2002); and
- Evaluation of levels of ticks and internal worms' 6 months after the extension as a tool to assessment of knowledge and skills application (March 2002 to May 2002).

Methods used for sampling were done according to Thrusfield (1995). The sampling frame was divided into three tiers; these were into the farmers, cattle, and parasites.

3.2.1 Sampling frame for farmers

A random sample of beef cattle farmers (n=30) with a minimum of 10 cattle was made from each of the 3 veterinary service delivery wards of the Moretele State Veterinarian Area.

3.2.2 Sampling frame for indicator cattle

On the same day five indicator cattle were sampled for ticks (*Iodidae*) and internal helminths (roundworms, tapeworms, and flukes). The indicator cattle were purposively selected to include two calves; two sub-adults aged 2 years, and one adult animal aged five years or older.

3.2.3 Sampling frame for parasites

Ticks types and their infestation levels were determined and worm eggs per gram were determined at Ondestepoort Agricultural Research Council laboratories. The sampling method used for each is shown below.

3.2.3.1 Ticks

Ticks were collected according to Tice (1995) as follows: adult feeding ticks were carefully removed with a forceps from various sites on the cattle to avoid crushing, and placed into a bottle of 70% ethanol. Site and animal specifications were properly made on the specimen bottle and samples were delivered to the laboratory for tick identification under a stereoscopic microscope.

3.2.3.2 Worms

The initial faecal samples were taken according to the method described by Reinecke (1989) and Hansen *et al.,* (1994). Arm length gloves were used to collect faecal samples from five (5) cattle of different ages (viz., two calves, two aged 2 years and one over 5 years). The faecal samples were then mixed thoroughly and pooled samples were made. The pooled samples were placed in 100 ml sterile plastic sample bottles and submitted in cooler boxes with ice packs to the Ondestepoort Agricultural Research Council parasitology laboratory for egg per gram (epg) determination.

The average epg was calculated using the following formula:

X = epg per pooled sample from 5 cattle;

X/5=epg per animal sampled from a herd.

3.3 Model system and experimental design

3.3.1 Model system

The model system that was used to design the extension was the Sender-Message-Channel-Receiver-Effect method (SMCRE) as described by Bembridge (1991) (see Fig 2. 1).

Sender:

AHTs from NWP (n=15) and Limpopo Province (n=29) were assessed about their extension knowledge on the control of cattle parasites in 2000. The method used was to give each a written assessment using questions and mounted specimens of ticks and worms. As in assessment in tertiary institution 50% was regarded as an acceptable level of knowledge. After the course, the AHT were re-examined using the same questionnaire and mounted specimens. The questionnaire is attached as Appendix 6. Although the AHT from NWP had a higher level of initial and final knowledge about tick and worm control than those from Limpopo Province, the results of the assessment revealed that the AHT who were to be involved in this study, did not have a satisfactory level of knowledge about the identification and control of cattle parasites. As such they would not be able to give acceptable extension to farmers in this regard (See Chapter 4, Section 4.3). They were therefore given further in-service training before the research with farmers and collection of specimens was undertaken.

Message:

At a livestock owners meeting held in January 2000, farmers indicated that their first priority was receive extension on cattle tick and internal worm control. An extension program was formulated in consultation and with the participation of farmers. Identification of cattle ticks and worms using common names, symptoms of disease / disorders caused by different parasites, as well as control strategies were incorporated in the extension program.

Channel:

Individual farmers' workshop and skills training were conducted. The extension materials were procured from the Department of Tropical Disease of the Veterinary Faculty at the University of Pretoria and the Agricultural Research Council Institute of Veterinary Research at Onderstepoort and the National Department of Agriculture and were allocated to the team of AHTs that was to conduct extension to farmers during the study.

Receivers:

Beef cattle farmers (n=90) with a minimum of 10 cattle, from Moretele District

Effects:

The effect of extension was assessed in two ways. First, through evaluation of farmers' knowledge levels before and after extension. Secondly, the application of extension was assessed by measuring the burden of ticks and internal worms in the indicator cattle before and after extension.

3.3.2 Experimental design

The experiment was carried out in three phases (Fig 3. 1).

Phase 1

The first or diagnostic phase started with situational analysis through participatory appraisal of the farmers' requirements for extension and their demographics, evaluation of base level of knowledge as well as sampling for the parasite burdens of indicator cattle. Thereafter, extension messages were designed to meet their situation and a search was made for extension material in which these messages were conveyed. The level of knowledge of AHT was assessed and those involved in the research were trained.

Phase 2

In the second phase, the visit and training of individual farmers was implemented over a three-month period.

Phase 3

In the third phase the level of knowledge of farmers and the implementation of extension was reassessed (See flowchart in Fig 3.1).

Fig 3.1 A flowchart showing the phases of the research.

Phase 1: **Diagnostic research** **February 2001 to August 2001**	• Type of extension requested by farmers; • Knowledge evaluation of AHT; • Evaluation of farmer demographics, baseline knowledge about cattle ticks, and worms; • Sampling for ticks and worms (March – May2001) in indicator cattle; • Evaluation of data; • Development of extension messages.
↓	
Phase 2: **Implementation (Extension)** **September 2001 to November 2001**	• Workshop on tick and worm control Sept 2001 • Knowledge and skills training of farmers using individual farmer visit and training extension method • Evaluation of farmers knowledge after workshop (same day of extension)
↓	
Phase 3: **Evaluation of effect** **March 2002 to May 2002**	• Evaluation of farmers knowledge 6 months after their workshop (March to May 2002); • Evaluation of the level of ticks and internal worms 6 months after extension (March to May 2002) and 12 months after initial sampling.

3.4 Experimental procedure and observation

3.4.1 Participatory situation appraisal meeting with farmers

The initial participatory appraisal of the farmers' situation was carried out in January 2001 during a meeting of all stakeholders and farmers.

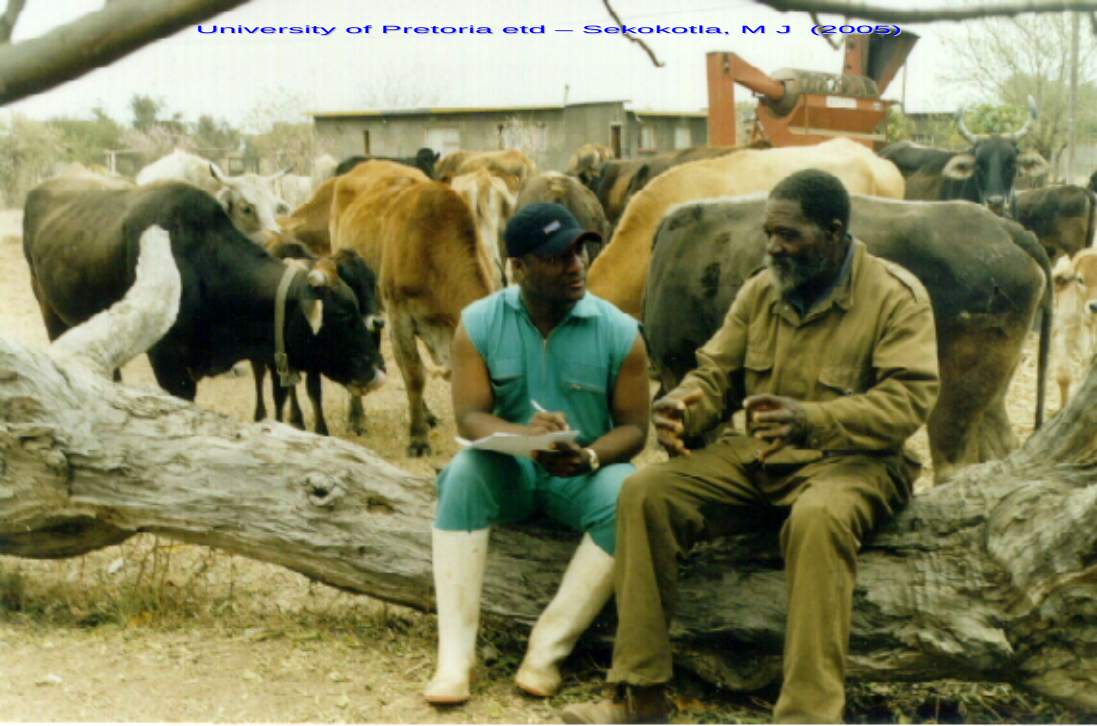
3.4.2 Evaluation of AHT knowledge and their training

The knowledge and skills of AHTs were evaluated and they were trained between February 2001 and March 2001.

3.4.3 Initial structured interview with farmers

Random selection (Thrusfield, 1995) was done to select farmers (n=90) as described above. These 90 farmers were visited individually and were subjected to a structured interview to gather data on demographics and to determine their knowledge level about control of cattle parasites. Appendix 1 shows the questionnaire that was used to interview farmers during these initial interviews. All questions were asked (phrased) in the farmers' home language and in an 'open' rather than a 'closed' manner by the trained AHT team.

Plate 3.3 is a photograph showing Mr. Maime (AHT of ward 3) interviewing a farmer during initial interviews.



3.4.4 Collection of samples of ticks and worms

Tick and worm samples were collected using methods described previously (Sections 3.2.3.1.and 3.2.3.2). Appendix 4 shows the labels that were used to label the tick and worm samples. Plate 3.3 and 3.4 shows a photograph of Mr. Maime, volunteer AHTs and a farmer just after initial sample collection during the first phase of this research study (March – May 2001).

3.4.5 Extension implementation

The analysis of interview questions and data on parasite types led to the collective development of a specific extension program for imparting knowledge and skills to the farmers. This is in line with conventionally accepted extension theory that suggests that extension must be relevant to the situation and needs (Bembridge, 1991). The AHT team then visited each farmer using the visit and training extension method. The following extension materials were used as teaching aids and extension materials:

- Photographs of ticks and worms (to teach identification),
- Mounted specimens of ticks and worms,
- Posters and pamphlets
- Flip charts.
- Video cassettes were played using a portable TV set.

3.4.6 Evaluation of farmers on the same day of extension

On the same day that extension was conducted, farmers were assessed about what they were taught. This was intended to evaluate their understanding and short term memory of the imparted extension knowledge and skills about cattle ticks and cattle internal worms (Appendix 2 shows the questionnaire that was used to interview farmers at this stage).

3.4.7 Evaluation of farmers knowledge 6 months after extension

The AHTs team re-visited the same farmers again 6 months after the completion of the extension campaign and interviewed them to assess their knowledge level and long-term memory of the imparted extension (Appendix 3 shows the questionnaire that was used to interview farmers at this stage).

3.4.8 Evaluation of application of knowledge six months after extension

The AHTs team collected ticks and faecal samples from the same five sentinel animals per farm sampled 12 months earlier, using the same methods.

3.5. Data Analysis

Data was analyzed through the use of a Microsoft Excel®. Means and frequencies were analyzed and interpreted with the assistance of a statistician using the methods described for survey data analysis by Thrusfield (1995).

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The results of the survey are divided into three categories:-

- Evaluation of knowledge of AHT prior to study
- Structured interviews to obtain data on demographics and knowledge level of farmers before and after extension.
- Data surveillance of ticks and worms before and after extension

The initial structured interviews were conducted with two groups of AHT using the questionnaire in Appendix 1, during January and February 2001. The initial structured interviews farmers were conducted using structured interviews (Appendix 2) March 2001 to May 2001. The results obtained from these interviews led to the planning of extension with the respondents.

The second interviews with farmers were done after extension to farmers, using the second questionnaire to farmers (Appendix 3) during September 2001 to November 2001. The aim of this was to evaluate the farmers' memory of the information imparted to them.

The third interviews were done using the third questionnaire (Appendix 4) during March 2002 to May 2002. The aim of these interviews was to evaluate the farmers' memory of the imparted extension six months after extension. The second assessment of cattle ticks and worms was done again from March 2002 to May 2002 and the aim was to evaluate the application of the knowledge of farmers about control of ticks and worms.

4.2 The results of the initial farmers interview (Phase 1).

4.2.1 Demography of farmers

The average age of the farmers (n = 90) was 65 years. The majority (n=65) of the farmers' interviewed kept their cattle on communal grazing, 15 farmers leased land and 10 farmers owned their own land (Fig 4.1).

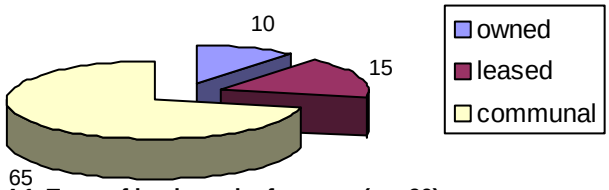


Fig 4.1 Type of land use by farmers (n = 90)

Fig 4.1 Type of land use by farmers n=90

The type of participation in farming was classified as full-time semi-commercial (owner has no other source of income and they were able to afford to lease or own individual camps), part-time semi-commercial (those who had another source of income other than farming), full time communal (animals kept on communal grazing, owner had no other source of income except pensions) and

part-time communal (owner had a another source of income). The frequencies in each of these groups are shown in Table 4.1.

Table 4.1 Types of participation in farming (n=90)

Type of participation in farming	Number of farmers (n=90)
Full time semi-commercial farming	8
Part time semi-commercial farming	6
Full time communal farming	60
Part time communal farming	16

From Table 4.1 it is evident that most of the farmers were full time communal farmers that had no other employment, although they may have had income from pensions, as many were over 65.

Farmers were asked about their future vision of their cattle-farming venture and the answers are shown in Table 4.2.

Table 4.2 Farmers' vision regarding the future of their cattle farming (n=90)

Vision	Number of farmers (n=90)
To become a commercial farmer	49
To retire from farming	3
To change to crop farming	0
To remain as I am	8
No vision	1
Cannot answer this	10
To have more cattle	10
To survive and support myself and my family	9

More than half of the farmers (n=49) envisaged a future where it is possible for them to expand into commercial farming and own land or lease individual camps. This was important when looking at how these farmers responded to extension messages. None of the farmers wanted to become crop farmers as they felt that crops are more easily stolen than animals.

Ten of the farmers wanted more cattle although they did not have an idea of what carrying capacity of the grazing land were. There were farmers who had no ambition to become commercial farmers (n=9); they only wanted to maintain food security for themselves and their households. These farmers only wanted "more cattle" for the survival of the household members. This was in line with findings of other researchers who have said that in traditional cattle keeping practices, the number of cattle is more important than their commercial value (Maree and Casey 1993). It is quite sad that 11 of the farmers had no vision; one felt that the vision is the responsibility of the government and 10 could not answer this question.

The farmers' other commitments and jobs that interfered with farming are shown in Table 4.3.

Table 4.3 Farmers' other commitments that interfered with farming (n=90)

Additional commitments	Number of farmers (n=90)
Teacher	3
Policeman	2
Headman	2
Working at firms	3
Businessman	11
None	57
Community worker	8
Street vendor	4

There were many other activities that were cited as interfering with farming but the majority of farmers (n=57, 63%) were pensioners who said that they do not have any other activity that interfered with their farming activities.

Farmers were asked about other people that helped them to care for their cattle (Table 4.4)

Table 4.4 People that assisted farmers' (n=90) with the caring for their cattle

Assistant	Respondents answer
Wife	9
Son	20
Daughter	1
Parent	3
Relative or Friend	43
Hired Helper	21

It is evident that nearly a third of the farmers could afford to pay a hired helper. Sons, relatives and friends also assisted owners with their cattle. There is

overlapping as farmers could check more than one option eg. they could be living friends or relatives to look after cattle

4.2.2 Soil types, vegetation types, and water supply

The AHT classified the soil types and vegetation types in their respective wards, using Acocks (1975) and Taiton (1981). Tables 4.5 (i), (ii), and (iii) show the results.

Table 4.5 Soil type per AHT ward.

(i) Ward 1: Mr. Nthite

Soil type	Land size
Sandy-Loam	50 000 ha^2
Sandy	7 000 ha^2
Loam	20 000 ha^2

(ii) Ward 2: Mr. Maime

Soil type	Land size
Sandy-Loam	33 000 ha^2
Sandy	5 000 ha^2
Loam	27 000 ha^2
Clay	14 000 ha^2

(iii) Ward 3: Ms. Kaotsane

Soil type	Percentage of study area
Sandy-Loam	21 000 ha^2
Sandy	2 300 ha^2
Loam	19 000 ha^2
Clay	7 000 ha^2

Table 4.6 Vegetation type in the whole study area

Vegetation type	Percentage of study area
Mixed veld	31 %
Sour veld	50 %
Sweet veld	9 %

Farmers were asked about the size of the land they used for cattle farming. All the farmers using the communal land confessed that they did not know the size of the available grazing or farming land and gave arbitrary (guessed) figures. Farmers that occupied leased land and farmers that owned the land had lease contracts and title deeds that showed the sizes of the land and these sizes ranged from 10 ha to 2546 ha.

The types of water sources used for cattle farming are shown in Figure 4.2. Tap water is supplied by the relevant municipality and is either piped to the area or supplied from bulk tankers. Tshwane (Apies) and Moretele (Pienaars) rivers run though the study area. They and their tributaries supply water to communal grazing and leased lands. This is the main water supply for the cattle farmers Boreholes are driven by electricity or wind pumps. Earth dams are to collect rainwater or dam up dongas or small streams.

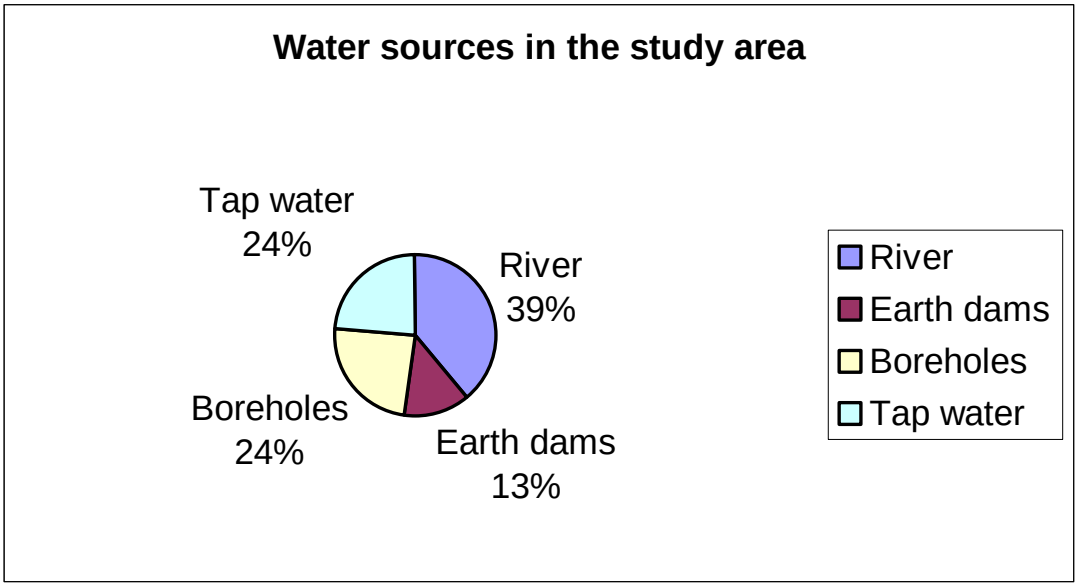


Figure 4.2 Water sources in the whole study area

Seventy-one percent of the respondents were satisfied with the water supply throughout the year while 17 % where dissatisfied about the annual water supply. The dissatisfied farmers mentioned that the water was scarce during the dry months of winter (Moretele area has a summer rainfall climate). Twelve percent did not know what to say with regard to this question - they had no idea where their cattle obtained water.

4.2.3 Livestock farming system practiced and the type of cattle breeds kept

Eighty-nine of the respondents practiced extensive beef farming with cross - breeds or mixtures of Afrikaner, Brahman, Nguni, Jersey and Friesland cattle. One farmer owned a herd of Brown Swiss cattle that were kept for the production of both milk and meat.

4.2.4 Comparative evaluation of level of farmer's knowledge about cattle ticks and internal worms

In Phase 1 (see Chapter 3) the base level of knowledge of the farmers about ticks and worms was evaluated using a questionnaire (Appendix 1). Thereafter it was reevaluated (Phase 2 and 3). The level of knowledge about ticks, tick-borne diseases and tick control is discussed in Section 4.2.4.1. The level of knowledge about worms, diseases caused by worms and worm control is discussed in Section 4.2.4.2.

4.2.4.1 Level of knowledge about ticks, diseases, and tick control.

All farmers (n=90) were asked if they knew which ticks transmitted which diseases or caused which conditions. The questionnaire was presented initially (Phase 1), repeated directly after extension (Phase 2) and 6 months later (Phase3). Figure 4.3 and 4.4 shows the frequencies of their answers to these questions as a comparison between the first, second and third interviews. From Fig. 4.3 and Fig. 4.4 it is evident that the farmers knowledge increased substantially after extension (Phase 2) and showed a decline during the third interview (Phase 3). This is an important finding as it shows that farmers do not necessarily remember extension messages for a long time and may be one explanation for the apparent lack of success of extension to farmers. Therefore the same messages have to be repeated.

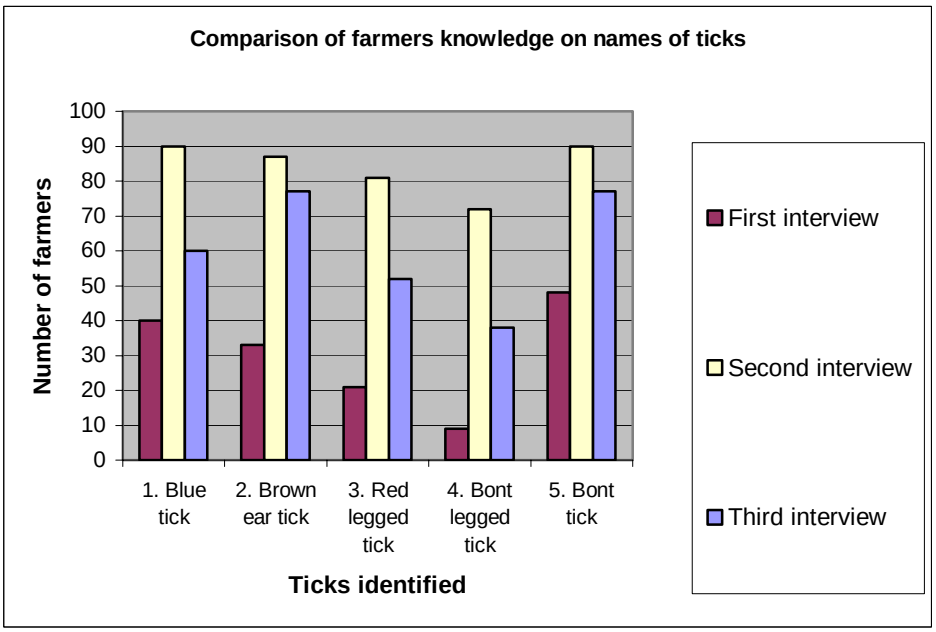


Figure 4.3 Comparison of farmers' knowledge about names of ticks (n=90).

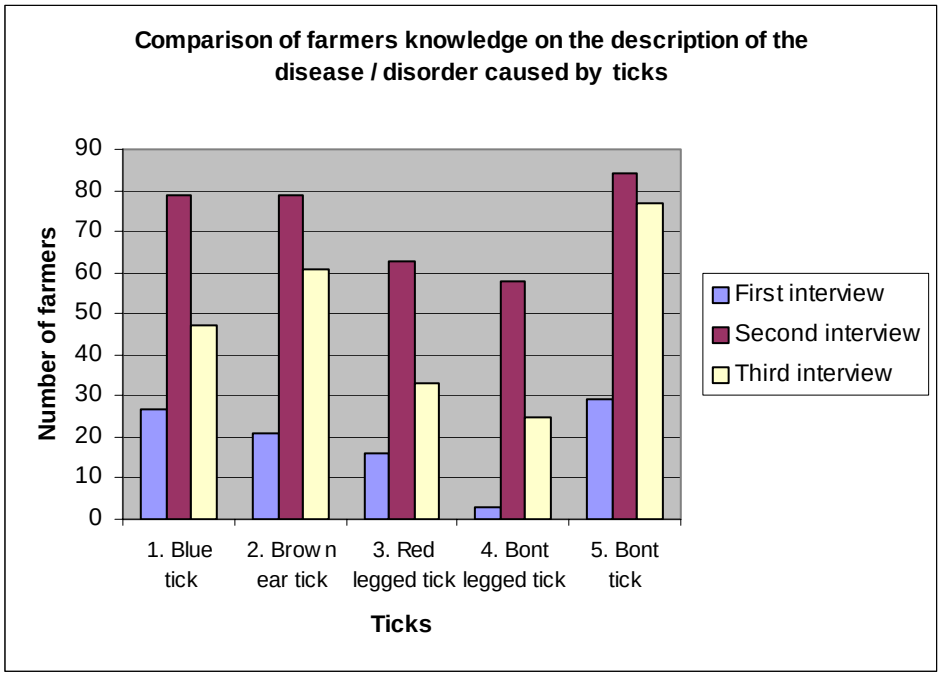


Figure 4.4: Comparisons of level of farmers' knowledge about the diseases/ conditions caused by ticks (n=90).

All farmers (n=90) were asked in phase 1 if they were dipping their animals and 82 of them said that they dip cattle while 8 of said they did not. Only the eight farmers who said that they do not dip were asked to give the reasons for not dipping their cattle. Table 4.7 reflects their reasons for not dipping their cattle. It is interesting that only three farmers did not have crush pens. It was observed that most farmers built their own small crush pens because state crush pens were stolen by illegal settlement dwellers. The five that forgot to dip was probably due to more advanced age. Another reason is that chickens and birds have been observed to remove ticks form cattle, in the same way that ox-peckers remove them from game. Dips used on the cattle can kill these chickens. Use of the newer acaricides such as Fluomethrin will not cause death of chickens and this may be a good way to motivate for the use of acaricides to control ticks.

Table 4.7 Farmers' reasons for not dipping their cattle (n=8)

Reason	Number of farmers
Lack of crush pens	3
High cost of dipping	2
Medicine wholesalers too far away	2
Forget to dip	5
Dipping is the duty of the state	1
Chickens / wild birds clean ticks from cattle	4
Animals are too wild to dip	3

The 82 farmers who said that they dip their cattle for ticks were further asked to mention their reasons for dipping (Figure 4.5).

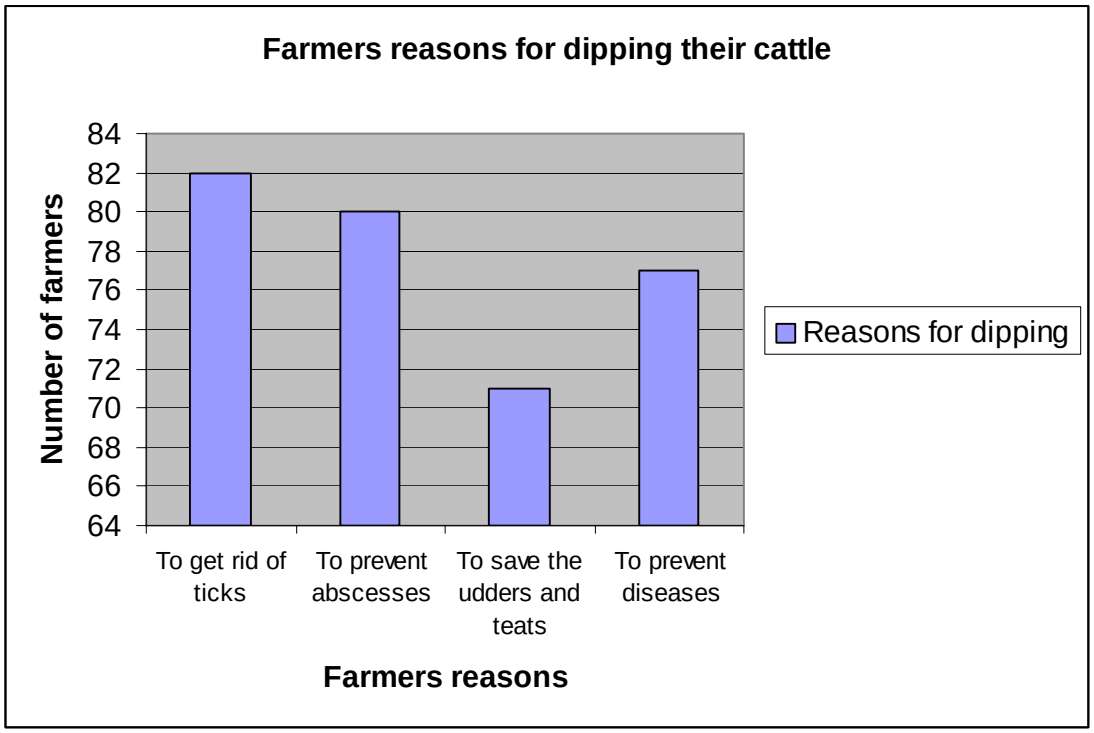


Figure 4.5: Farmers reasons for dipping their cattle (n=82)

In phase 2 all 90 farmers were asked if they were going to dip their cattle and all 90 of them said that they were going to dip their cattle. The respondents were asked to give the reasons for dipping cattle and Table 4.8 serves to give the results of their answers to this question.

Table 4. 8 Farmers reasons for dipping their cattle

Reason	Phase 2 (n=90)	Phase 3 (n=81)
To get rid of ticks	90	25
To prevent abscesses	90	22
To save the udders and teats	87	14
To prevent diseases	90	20

In phase 3 all 90 farmers were asked if they were dipping their animals and 81 of them said that they dip while nine said they do not. Table 4.8 shows farmers (n=81) reasons for dipping in the third phase. The nine farmers who said that

they do not dip mentioned the factors reflected on table 4.8 as their reasons for not dipping. Farmers could give more than one reason.

Table 4. 9 Farmers' reasons for not dipping their cattle (n=9)

Reason	Number of farmers
Lack of crush pens	7
High cost of dipping	4
Places to purchase remedies too far	2
Forget to dip	6
Dipping is the duty of the state	1
Animals are too wild to be dipped	3

Eighty-one farmers who said that they dip their cattle for ticks mentioned the factors reflected on the prevous table 4.8 as their reasons for dipping:

Table 4.10 People who were involved in dipping of cattle

Person	Respondents dipping Phase 1 (n=82)	Respondents who said they would dip Phase 2 (n=90)	Respondents dipping Phase 3 (n =81)
Self	82	90	81
Wife	9	11	1
Children	17	25	4
Relative/friend	67	67	74
Employee	21	70	79

The above changes (Table 4.10) in the type and number involved in dipping are interesting. In phase 2, obviously all the farmers became motivated to dip, following the farmers day. Six months later, one less farmer was dipping than at the start of the study. It also appears that a large number of children, relatives and friends started to ask payment for assisting with dipping as this rose from 21

to 79. Although farmers claimed 9 wives were helping at the beginning of the study (phase 1) only 1 was helping by phase 3. Perhaps they were replaced by paid helpers.

Table 4.11 Dipping frequency

	Phase 1 (n=82)	**Phase 2 (n=90)**	**Phase 3 (n=81)**
Once a month throughout the year	66	_	_
Once a month in dry season and twice a month in wet season	13	_	14
When see “enough” ticks	3	_	_
When > 20 adults ticks per cow	_	90	64

From table 4.11 it can be seen that after the farmers day, all the farmers resolved to follow the method of tick control to promote endemic stability – dipping only when see > 20 adults ticks per cow. Six months later, those who dip twice a month in the rainy season and once a month in the dry season were joined by one farmer. However 64 of the farmers were dipping only when they saw more than 20 adult ticks per cow. The 14 farmers who dipped 2x monthly in the rainy season and monthly in the dry season could have been influenced, being conditioned by the method followed by the state for many years, to combat corridor disease (Coetzer et al.; 1994).

In phase 1 the eighty-two farmers that dipped their cattle were asked to give names of acaricides they used on cattle and Table 4.12 reflect their answers.

Table 4.12 Acaricides used by farmers

Acaricide name	Phase 1 (n=82)	Phase 2 (n=90)	Phase 3 (n=81)
Drasticdeadline*	30	90	63
Triatix**	55	90	71
Home made mixtures	2	0	1
Injectable acaricides	2	77	20
Jeyes fluid***	5	0	2
Dazzel****	2	51	43
Pour-on	3	43	47
Old motor oil	3	0	1
Tick grease	3	63	13
Bacdip*****	19	79	35

* Drastic Deadline ® Bayer Animal Health. Flumethrin 1% Pour -On acaricide

**Triatix Cattle Spray ® Intervet Pty Ltd., Amitrix 12.5% dip concentrate

*** Jeyes Fluid ® Carbolic disinfectant (not a registered acaricide)

****Dazzel N F ® Bayer Animal Health. Diazinone 30% dip concentrate

***** Bacdip Aerosol ® Bayer. Flumethrin 0.2% spray-can

Farmers named more than one dipping remedy and it was evident from discussions with the farmers, that they were using different types of dips randomly and this situation might have let to acaricide resistance.

The use of Jeyes Fluid as an acaricide probably dates back to the use of Carbolic dips for tick control more than 50 years ago. Extension workers and veterinarians do not recommend this practice, however, farmers maintain it is cheaper than dips and also kills the ticks. This finding also agrees with findings

by other authors (Mokantla, 2003). Often farmers extend the use of acaricide by diluting them with other substances like cooking oil or citrus skin oil. This is illegal and dangerous as it can result in residues. Before extension 10 farmers were using homemade mixtures, Jeyes Fluid and old motor oil to control ticks. Immediately after farmers day, 0 farmers said they would use them. Six months later 4 farmers were using these remedies. The extension seems, therefore to have made an impact as there is also a better use of a variety of acaricides (see column 3) than in phase 1.

Table 4.13 shows that farmers were initially using several different types of dipping methods and that hand spraying with liquid mixture of dip and water was the favoured method (n=61), with the second most frequently used being pour-ons (n=21). The few farmers (n=2) that used plunge dips was probably because dipping is no longer subsidized and it is only cost-effective to use plunge dips if the farmer owns a very large herd of cattle. Work by Tice (1995) in Jericho District, North West Province, showed that pour-ons were probably the most convenient and cost effective method of tick control for communal farmers.

All respondents (n=82) claimed to be using the right dilution according to the instructions on the leaflet found with the dip or according to advise given by the farmers' co-operative personnel, however there was no way of verifying this. All respondents (n=82) were asked if they were satisfied with the level of tick control on their herds. Of these, 61 said that they were satisfied while seven farmers

said that they were not satisfied. Fourteen farmers said that they were uncertain about the effectiveness of their tick control.

Table 4.13 Acaricides application method favored by farmers

Dipping method	Phase 1 (n=82)	Phase 2 (n=90)	Phase 3 (n=81)
Plunge dip	2	90	90
Spray race	5	90	90
Hand spray	61	90	90
Hand dress	10	90	77
Pour on	21	90	81
Injectable	3	83	67
Acaricide tags	0	0	0

From table 4.13 it may be seen that in Phase 1 most farmers were using hand spraying or pour ons. The extension messages informed them of all the possible acceptable method of acaricide application. In Phase 2, the question became not what are you using at present, but what are acceptable methods of application. Possibly because of the demonstration of the spray race, hand spray and plunge dip during farmers day, the farmer remembered them well 6 months later (Phase 3). Interesting that not all farmers grasped the possibilities of injectable acaricides directly after the farmers day (n=83; phase 2), however all 90 farmers remembered the other ways of applying acaricide. As part of this section, farmers were asked if they were satisfied with the level of tick control in their herds

Table 4.14 Satisfied with level of tick control

Phase	Satisfied	Not satisfied
Phase 1 (n=82)	62	20
Phase 2 (n=90)	90	0
Phase 3 (n=81)	81	0

It seems thereof that the level of satisfaction with tick control improved after extension amongst those who dip their cattle regularly.

Table 4.15 Places where farmers who were dipping or wanted to dip cattle could buy acaricides

Name of merchant/outlet	Phase 1	Phase 2	Phase 3
Moretele State Veterinarian's Office	3	90	6
University of Pretoria Veterinary Hospital	3	90	23
University of Pretoria Makapanstad Veterinary Satellite Clinic	6	90	49
Pienaarsriver Farmers Cooperative	42	90	46
Bonn Accord Farmers Cooperative	18	90	58
Warmbaths Farmers Cooperative	20	77	21
Lion Bridge (in Pretoria)	23	70	42
Big Five Pharmaceuticals (OVI)	27	83	11

As seen previously, directly after the farmers day (Phase 2) farmers could name most of the outlets for acaricides. It appears that a significant difference exists between Phase 1 and Phase 3, which indicate that farmers gained knowledge on places where they could buy acaricides. It is also likely that farmers would also be more likely to remember those outlets that they had visited – if this is the case, the extension empowered choice. The farmers indicated during informal interview (Phase 3) that they had visited supplies in search of better prices and

services. In phase 1 ninety respondents were asked if they knew what ticks resistance to dips was and 17 of them gave the correct answer to the question while 73 of them failed to give the right answer to this question.

In phase 2 all the 90 respondents were asked if they knew what ticks resistance to dips was and 83 of them remembered the correct answer to the question while only 7 of them could not remember the right answer.

In phase 3 all the 90 respondents were asked if they knew what ticks resistance to dips was and 66 of them remembered the correct answer to the question while only 24 of them could not remember the right answer. There is a decline in memory of imparted extension. All farmers (n=90) were asked whether they understood the concept of resistance to acaricides (tick resistance to dips) and asked then to define it to demonstrate that they did understand (Table 4.16)

Table 4.16 Understanding the meaning of acaricide resistance

Phase	Understand	Do not understand
Phase 1 (n=90)	17	73
Phase 2 (n=90)	83	7
Phase 3 (n=90)	66	24

It can be seen that there was an improvement in knowledge when Phase 3 is compared to Phase 1. However, fewer farmers remembered after 6 months than directly after extension (Phase 2) as in previous tables, it appears that some farmers did not ever grasp the concept.

4.2.4.2. 2 Level of knowledge about symptoms of verminosis in cattle

In phase 1 the respondents (n=32) that said they knew about cattle worms were asked if they knew about the symptoms of the damage caused by internal worms of cattle and 24 of them said that they did not know, while eight asserted that did. The eight respondents, who said that they knew about the symptoms of the damage caused by cattle internal worms, were further asked what the symptoms (clinical indications) of worm infestation (verminosis) were. Their responses are reflected in Table 4.17.

Respondents (n=8) named more than one symptom and they all stated emaciation and diarrhea as the clinical indication of high worm infestation. It is surprising to note that only one farmer out of eight regarded high worm infestation as one of the causes of cattle deaths (particularly in calves) while seven did not think verminosis could lead to cattle death.

Table 4.17 Description of the symptoms of verminosis

Symptoms	Phase 1 (n=8)	Phase 2 (n=90)	Phase3 (n=74)
Emaciation (loss of weight)	8	73	74
Diarrhoea	8	73	37
Measles	3	61	12
Death	1	70	23
Bottle jaw		65	
Anaemia	1	57	11
Poor hair coat	5	69	31
Weakness and depression	3	70	53
Loss of milk in cows	2	59	41
Anorexia (poor appetite)	7	73	70

As found previously, the level of knowledge increased significantly between phase 1 and phase 3. However, in phase 2, farmers' memory and understanding of symptoms of verminosis was not 100% which indicates that the concept was new to them or not presented in a way they understood. There was, as in previous questions (Table 4.17) deterioration in long-term memory as the recall was significantly lower 6 months later (phase 3).

4.2.4.2.3 Control of worms in cattle

In phase 1, farmers (n=90) were asked if they were de-worming their cattle for internal worms and only 10 of them said that they were.

This is a much lower proportion than farmers who considered ticks undesirable. It may reflect the difference of opinion about the value of de-worming cattle between Veterinary Pharmaceutical representatives who sell anthelminthics and helminthologists such Reinecke (1989).

Certainly, less emphasis is placed on helminth control than tick control by the state veterinary extension services. This is probably because tick-borne disease like East Coast Fever causes severe economic losses in Africa (Coetzer *et al.,* 1994).

4.2.4.2.3.1 Reasons for de-worming cattle

These farmers (n=10) were further asked for the reasons that led them to de-worm their cattle (Table 4.18).

Table 4.18 Farmers reasons for de-worming their cattle (Phase 1)

Reason	No. of farmers
To get rid of cattle internal worms	10
To improve condition score	3
To prevent symptoms and death	1

From Table 4.18 it should be noted that farmers gave more than one reason for de-worming their cattle.

In phase 2 all 90 farmers were asked if it was necessary for them to de-worming their cattle for internal worms and all of them agreed that it was imperative to de-worm their cattle for internal worms. They were then asked the reasons for de-worming cattle and the following table serves to reveal their answers.

Table 4.19 Farmers' reasons for de-worming their cattle (Phase 2)

Reason	No. of the farmers (n=90)
To get rid of cattle internal worms	90
To improve condition score	90
To prevent symptoms and death	90

From Table 4.19 it is evident that the farmers all agreed that de-worming of cattle was important and knew the reasons for de-worming of cattle.

In phase 3 ninety farmers were asked if they were de-worming their cattle for internal worms and the reasons why they considered de-worming important. Of the farmers (n=90), 63 of them said that they were de-worming their cattle while 27 of them said that they did not. The reasons they gave for de-worming are shown in Table 4.20. Farmers could give more than one reason for de-worming their cattle.

Table 4.20 Farmers reason for de-worming cattle (phase 3)

Reason	No. of the farmers (n=90)
Rid of worms	63
Improve condition score	63
Prevent symptoms and death	59

4.2.4.2.3.2 De-worming programs

Only those farmers who said they were de-worming their cattle (n=10), were asked about the frequency of worm control during the rainy season and dry season. Three of these respondents said that they de-wormed twice during the rainy season and once during the dry months. The remaining seven respondents said that they treated their cattle once during the rainy seasons and once during the dry seasons. The respondents (n=10) were further asked about the types of de-worming remedies that they were using and all asserted that they only used liquid de-worming remedies orally.

In phase 2, after extension, the farmers (n=90) were again asked if they remembered the general de-worming program for an extensive cattle farming

system in their climatic condition of summer rainfall patterns. Their answers were that cattle were to be de-wormed 3 weeks after the first rain following winter and at the end of February. It was good that these farmers remembered what they taught during extension in this respect.

In phase 3, the respondents were again asked on the frequency of de-worming during rainy seasons and during dry seasons. Fifty-nine of them said that de-worming should be done 3 weeks after the first rain following winter and again at the end of February. Fifteen farmers said that they their cattle for worms anytime once during the rainy seasons and once during the dry seasons. These 15 farmers did not implement extension as taught by the extension personnel – namely to de-worm 3 weeks after the first rain following winter and again at the end of February.

4.2.4.2.3.3 De-worming remedies

The farmers (n=90) were asked about the types of de-worming remedies that they would use in cattle if they dewormed them (Table 4.21). The choice was between oral liquids, oral powders and injectables.

Table 4. 21 Anthelmintics farmers could use

De-wormer type	Phase 1 (n=90)	Phase 2 (n=90)	Phase 3 (n=74)
De-worming liquids	90	90	42
De-worming powders	20	47	6
De-worming injections	46	79	26

In phase 2, respondents were asked on the types of de-worming remedies to be used and table 4.21 reveal their answers. In phase 3, respondents were again asked on the types of de-worming remedies to be used and table 4.21 reveal their answers. The respondents (n=74) were further asked about the types of de-worming remedies that they were using and table 4.21 reveal their responses to this question.

4.2.4.2.3.4 De-worming methods

Worm remedies can be administered by dosing, by putting powders in the food and by injection. In phase 1, farmers that said they de-wormed cattle (n=10) were asked about the de-worming methods they used and they all said that they used the oral dosing method. After phase 2, all farmers remembered all three methods equally well. After phase 3, all farmers remembered the oral and injectable way of de-worming, but only 74 remembered that powders could be used in the food.

The difference between phase 2 and phase 3 is notable, however it is difficult to determine whether the 74 farmers were actually de-worming their cattle as they were taught during extension, de-worming as they thought best, or not de-worming at all. Perhaps the de-worming extension method suggested by the AHTs was not acceptable to all the farmers. The state suggested the method advised by the helminthology section of Onderstepoort Veterinary Institute, based on helminthology research. However, indigenous knowledge is valuable,

and perhaps the method used by the 15 farmers was based on their own experience in Moretele and was valid. From these answers it was also considered that if farmers were randomly using different types of de-worming remedies, this situation could lead to development of resistance to anthelmintics.

4.2.4.2.3.5 Places where de-worming remedies are sold

A comparison between the places that farmers said that de-worming medications could be bought in phase 1, 2 and 3 is shown in Table 4.22

Table 4.22 Places where farmers bought de-worming remedies (Comparison of phases 1, 2 and 3)

Name of de-wormer selling outlet	Number of farmers (n=90)		
	Phase I	**Phase II**	**Phase III**
Moretele State Veterinarian's office	1	70	6
University of Pretoria Veterinary Hospital	1	90	11
University of Pretoria Makapanstad Veterinary Satellite Clinic	2	90	9
Pienaarsriver Farmers Cooperative	4	90	25
Bon Accord Farmers Cooperative	5	90	7
Warmbath Farmers Cooperative	4	77	11
Lion Bridge (in Pretoria)	8	70	14
Big Five Pharmaceuticals (OVI)	4	83	5

It is interesting to compare this to Table 4.22 where farmers listed the places where they buy dips. It appears that they did not realize acaricides and anthelmintics could be bought from the same outlets. Once again there is an improvement in knowledge between Phase 1 and Phase 3, but far less than was the case with acaricides (Table 4.15). Answers to Phase 2 are identical, however, and it appears that most farmers learnt from the farmers' day.

4.2.4.2.3.6 People involved in deworming the cattle

Farmers were asked who helped with deworming their cattle. In Phase 1, only 10 of the 90 farmers were deworming cattle. In Phase 2, after the farmers day, the question was " who do think will help with deworming" and the results are not really proportional – although it is interesting to note that 70 of the farmers considered employing someone to assist. In Phase 3, 74 owners claimed to be deworming cattle. It is not known whether they were truthful or answering the question as they thought it should be answered. This "lie factor" is always a possibility when working with communities (Moosdijk & Schiferli, 2001). It is still interesting that 65 of the 74 thought it was good idea to employ someone to help- really the same proportion as the 8 farmers out of 10 who dewormed cattle initially (phase 1).

Table 4.23 People farmers involved or wanted to involve when deworming their cattle

Person	Phase 1 (n=10)	Phase 2 (n=90)	Phase 3 (n=74)
Self	10	90	74
Wife	1	11	5
Children	2	22	15
Relative/Friends	8	67	62
Employee	8	70	65

4.2.4.2.3.7 Reasons for not de-worming cattle

In phase 1, farmers who did not de-worm but knew what worms were (n=22), were questioned on the reasons for not de-worming and their answers are shown in Table 4.24 below.

Table 4.24 Farmers (n=22) reasons for not de-worming their cattle (Phase 1)

Reason	Number of farmers
Lack of crush pens	7
Expensiveness of de-worming	8
Medicines wholesalers too far	8
Lack of effective state agricultural extension service about de-worming	15
Forget to dose	10
Dosing is the duty of the state	5
Animals are too wild for dosing	5

The fact that 15 of the 22 said that extension messages about de-worming were not effective may reflect the lack of emphasis on de-worming.

In phase 2, all 90 farmers said that they were going to de-worm their cattle for internal worms. In phase 3 twenty-seven farmers who said that they do not de-worm their cattle for cattle internal worms were also questioned on the reasons they were not de-worming their cattle and their answers are shown in Figure 4.6.

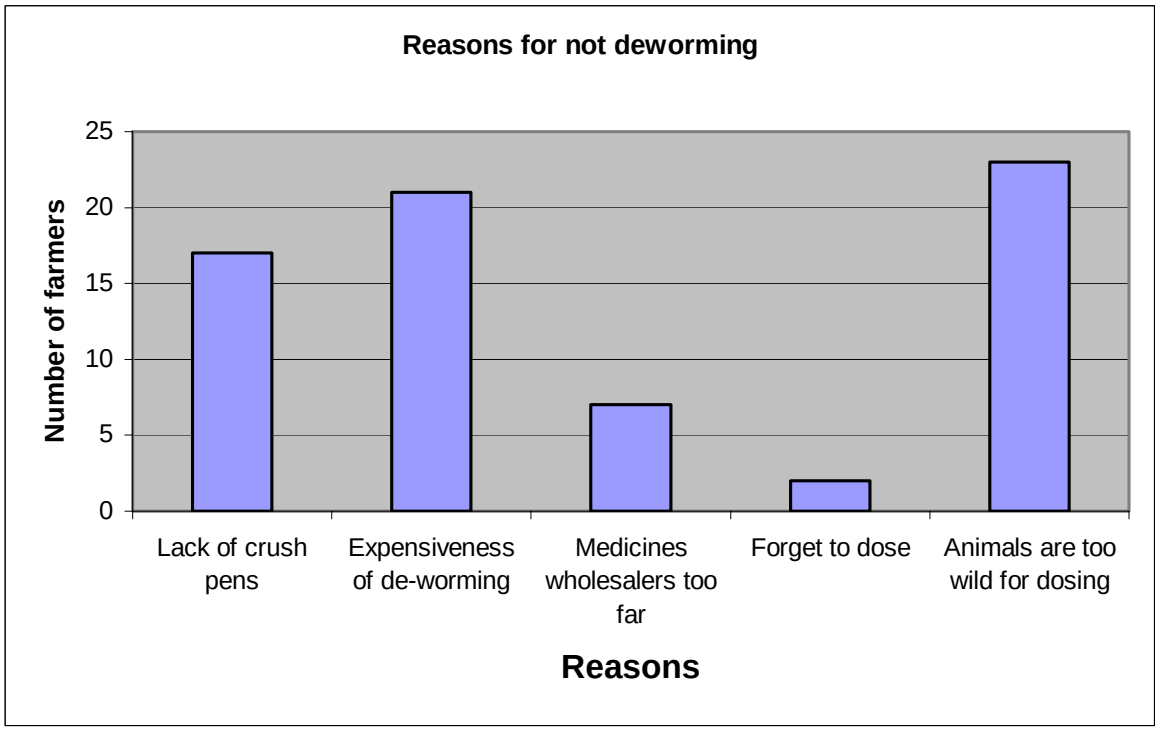


Figure 4.6: Farmers (n=27) reasons for not de-worming their cattle

4.2.4.2.3.8 Evaluation of farmers knowledge about resistance to anthelminthics

In phase1, all farmers (n=90) were asked if they knew what resistance to de-worming remedies was and to describe it. Only two of them knew the correct answer to the question while 88 of them did not know the right answer.

In phase 2 all the farmers were asked if they remembered what resistance to deworming remedies was and to describe it. Eighty-three of them said that they remembered while seven of them said that they did not. The 83 farmers who said

that they remembered, were then asked to describe what worm resistance was and only 69 of them got the answer right while 14 of them could not remember the right answer. It is therefore important to note that what the farmers claimed to know was not necessarily correct. In phase 3 all the farmers (n=90) were again asked if they knew what resistance to de-worming remedies was. Only 42 of them gave the correct answer to this question while 48 did not know the right answer. This shows a decline in farmers' memory over the six months since the extension imparted to them.

4.3 Surveillance for parasites in indicator cattle

Five indicator cattle in each herd were sampled for ticks and worms initially (Phase 1). After extension, they were re-sampled the following year at the same time of the year (12 months later).

4.3.1 Cattle tick levels

Five different adult tick species were collected during the period March 2001 to May 2001 (autumn) from five cattle per predilection site, by the Moretele veterinary extension staff according to the procedure described by Tice (1995). Figures 4.7, 8 and 9 show a comparison of the average tick burden, per ward for the initial (autumn 2001) and second sampling period (autumn 2002).

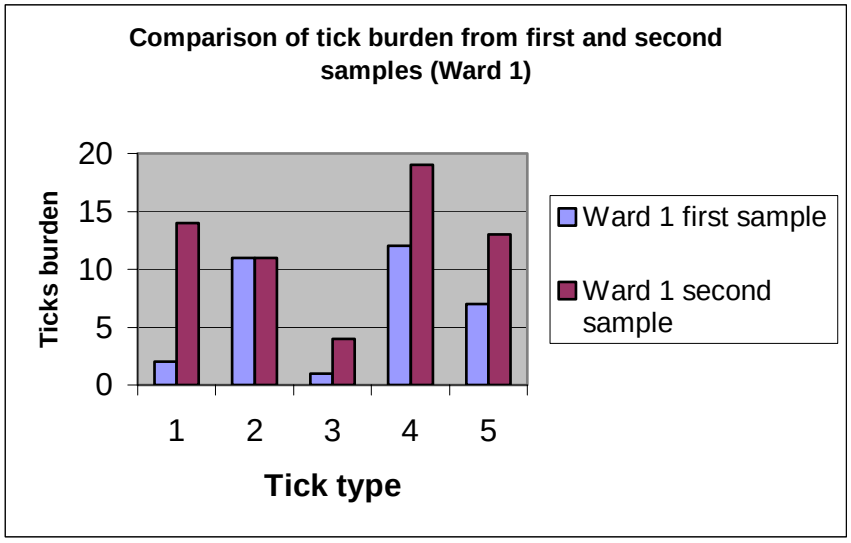


Fig 4.7 Comparison of ticks in indicator cattle, Ward 1 (see Legend)

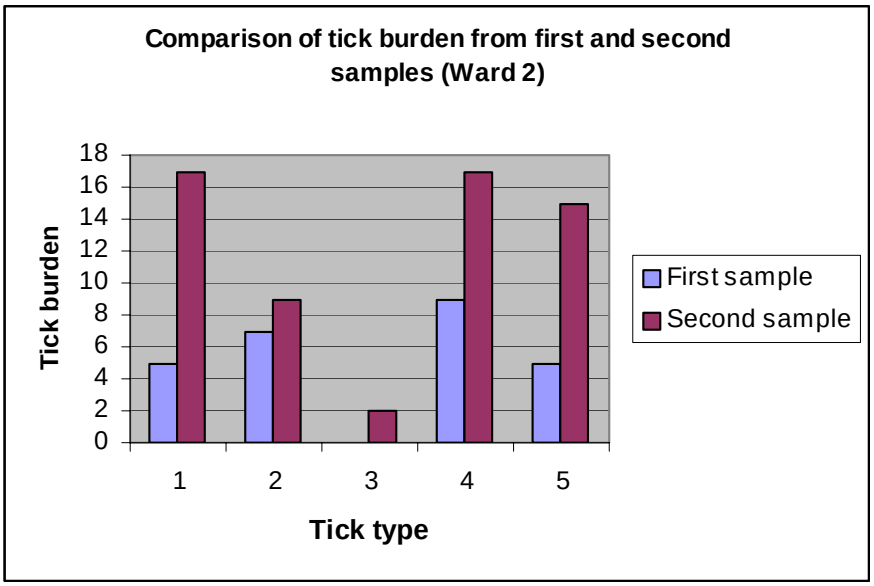


Fig 4.8 Comparison of ticks in indicator cattle, Ward 2 (see Legend)

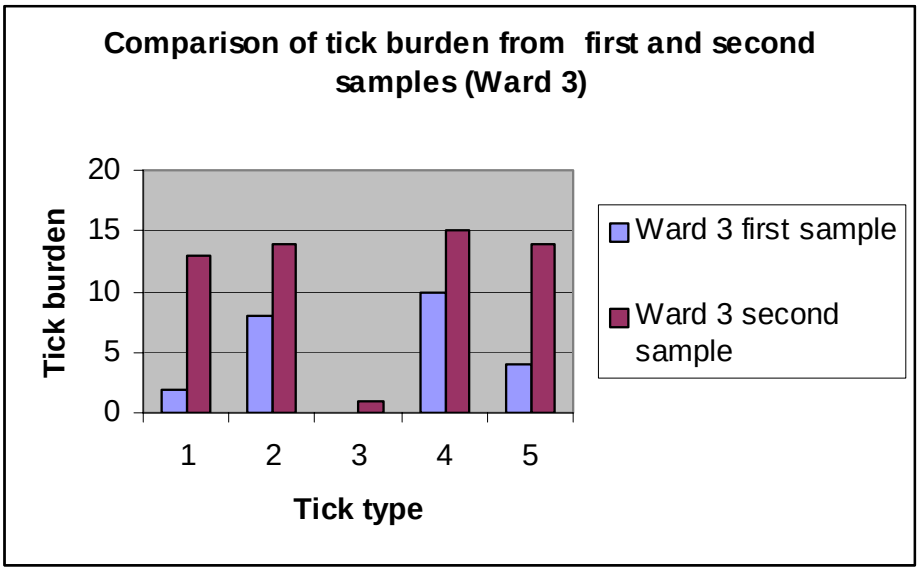


Fig 4.9 Comparison of ticks in indicator cattle, Ward 3 (see Legend)

LEGEND for Figs 4.12, 4.13, 4.14
Types of ticks

Tick no.1 =*Boophilus decolaratus*,
Tick no.2 =*Amblyomma hebraeum*,
Tick no.3 =*Hyalomma truncatum*,
Tick no.4 =*Rhipicephalus appendiculatus*
Tick no.5= *Rhipicephalus evertsi evertsi*.

It is noted that there is a slight rise in the burden of cattle ticks in the second survey that was conducted after extension. The difference was, however, not considered to be significant, as less than 20 ticks is considered a "mild" infestation (Spickett *et al*, 1990; Tice, 1995; Tice *et al*, 1998). The small difference between 10 and 15 ticks per animal was more likely to be due to slight environmental differences between 2001 and 2002, than a change in tick control methods by farmers.

4.3.2 Cattle internal worms levels

The Moretele state veterinary extension personnel collected faecal samples from the same 5 indicator cattle from which they collected tick samples, mixed them, and made one pooled faecal sample. These samples were placed in a cooler box with ice packs and were delivered to the Onderstepoort Veterinary Research Institute for epg determination, as described in Chapter 3. Dr. Vatta classified the worm groups from the eggs as follows: Conical flukes and Strongyles. Figure 4.10 and Figure 4.11 show a comparison of average worms burden for the initial (Autumn 2001) and second sampling (Autumn 2002).

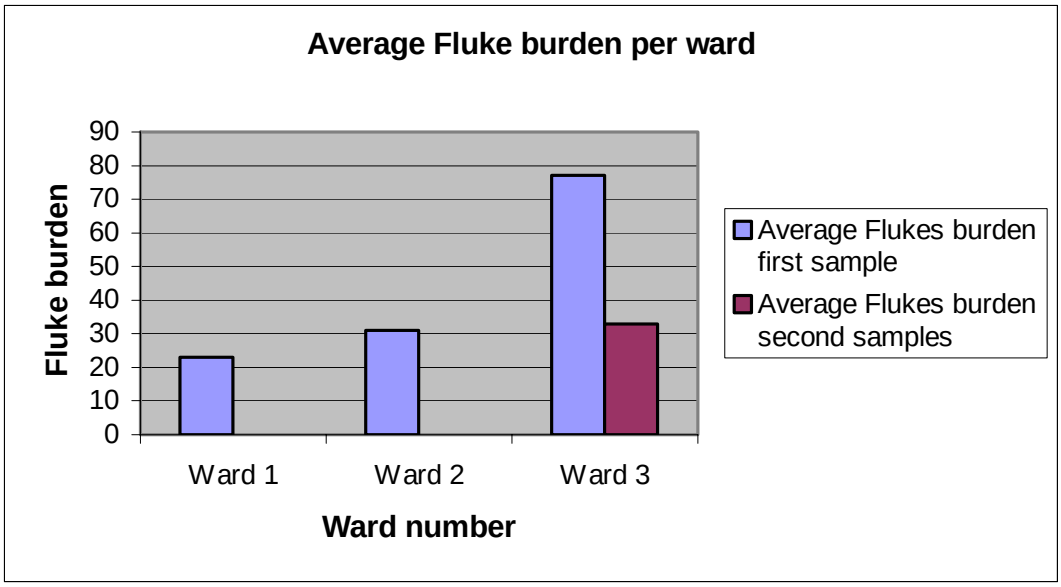


Figure 4.10: Comparison of average fluke burden per ward

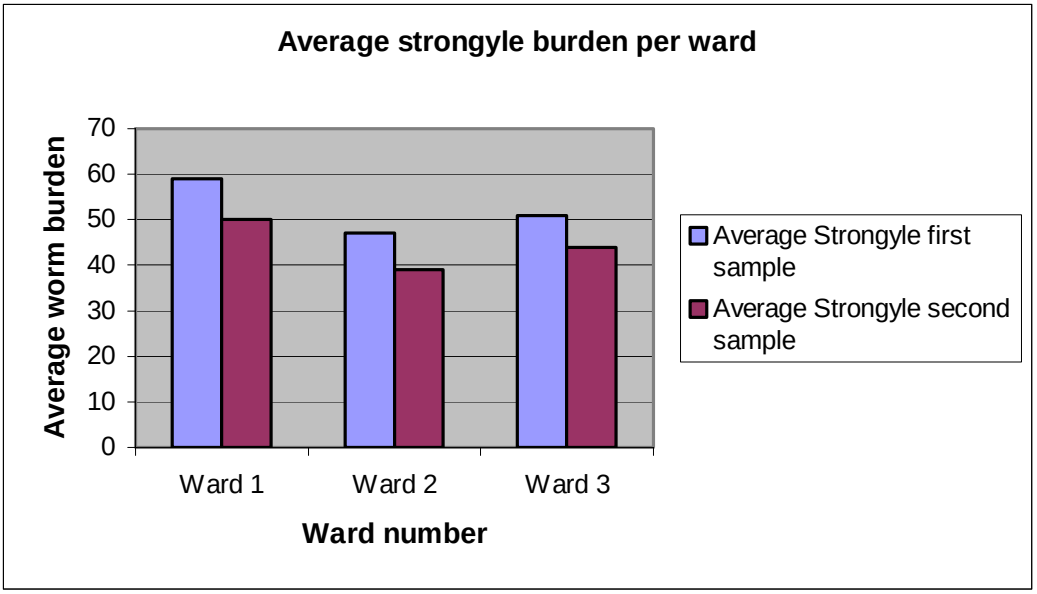


Figure 4.11: Comparison of average strongyle burden per ward

From Figures 4.10 and 4.11, it is evident that there was a mild worm infestation in the respondents herds in autumn. This is also in line with the findings of Dr. Adriano Vatta who conducted research on prevalence of worms in cattle during the period January 2001 to January 2002, in the Moretele state veterinarian area.

There is no significant difference between the two levels, as less than 1000 epg is considered as "low". The findings support the contention of Reinecke (1989) who did not consider the control of cattle helminths to be of great significance to the health of communal cattle. As in the case with ticks, increased knowledge by the farmers did not make an appreciable difference to the levels of parasites in the cattle. In fact it appears that the current control of parasites by farmers is adequate.

There was a significant improvement in the knowledge and skills of the farmers regarding cattle ticks and internal worm control but there were no differences in the initial and second cattle tick and internal worm burden levels. The following are the possibilities for this scenario:

- Farmers did not apply the extension education and training that they had received due to issues such as the fact that it is not cost effective to implement
- Ticks and worms were resistant to the remedies that farmers were using to control them; and lastly and
- There was a situation of endemic stability with low tick and worm burdens in cattle.

4.4 Evaluation of extension officers' knowledge

Veterinary extension is done by AHT who qualified at different institutions including Technikon RSA, Fort Cox Agricultural College, Tompi Seleka Agricultural College, Fort Hare University, University of the North and the University of the North West (Unibo and Taung College of Agriculture). The qualifications included two-year certificates, three-year diplomas, four-year diplomas, B Tech and B.Sc. Agric (Animal Health). With time, this has been rationalized and in 2004, only two institutions are able to present tertiary qualifications for animal health technicians, these are Technikon SA (which has merged with Unisa to become Technisa) and University of the North West (previously Unibo).

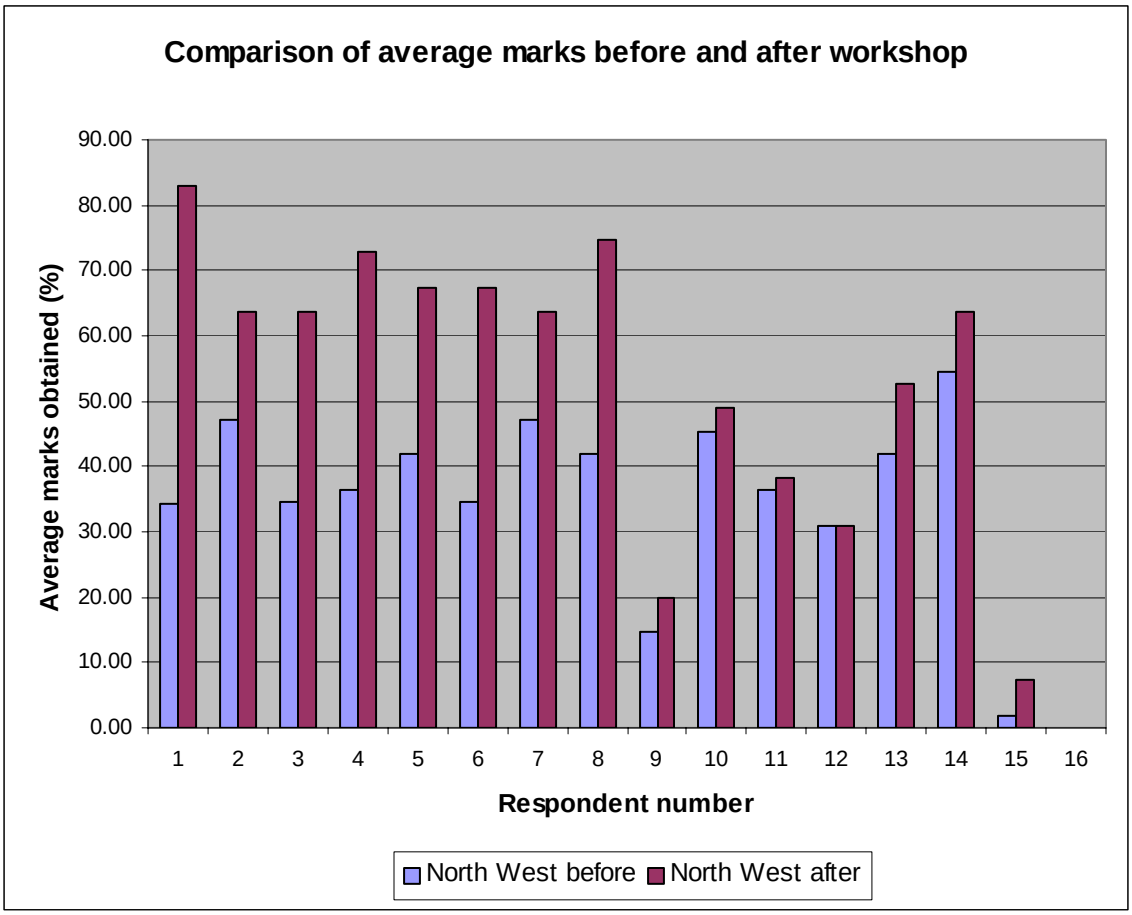


Fig 4.12 A comparison of the average marks obtained by AHT (n=15) from North West Province before and after a course on cattle tick and worm control

The qualifications offered previously varied a lot in content and quality. In all cases, however, the state veterinarian was expected to do in-service training.

This part of the study was done to evaluate the level of knowledge of the AHT about ticks and worms before and after they were given a short course on tick and worm control to update their knowledge (Appendix 6 : Questionnaire given to AHT).

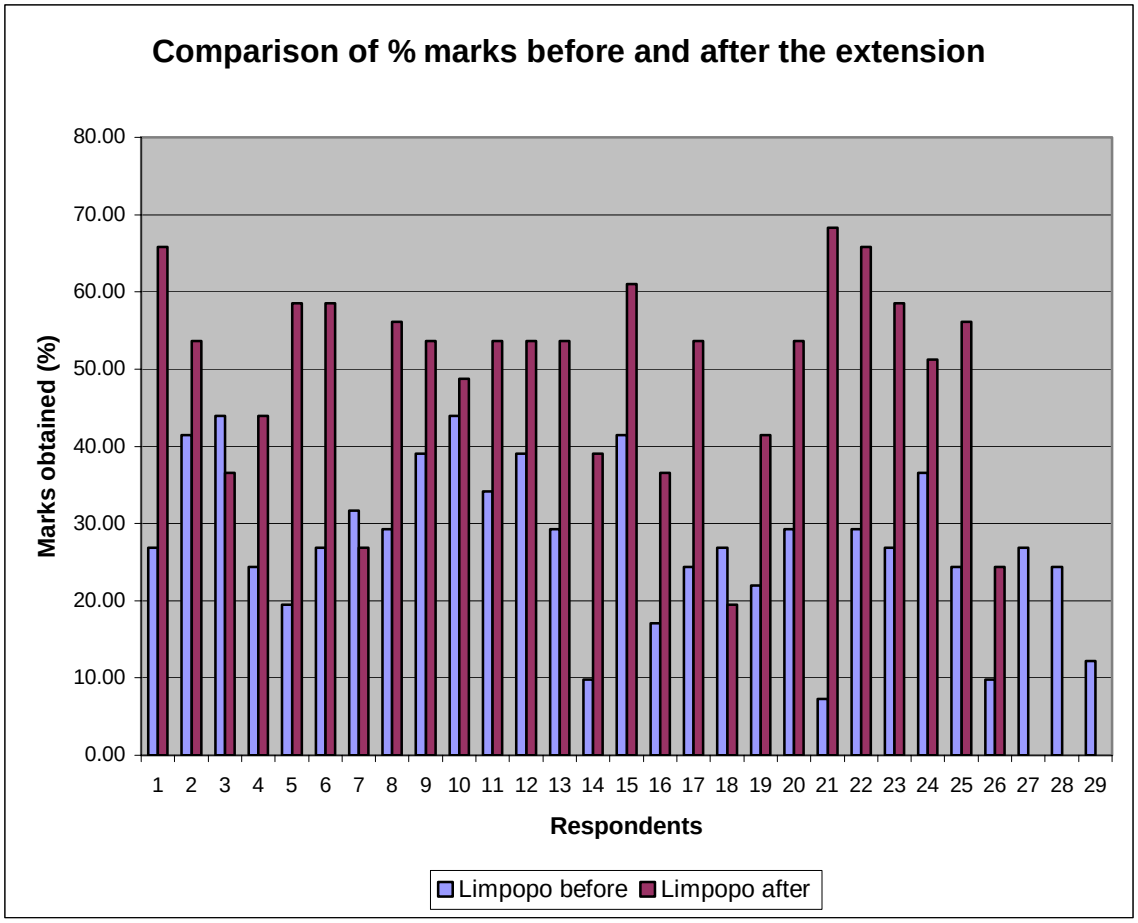


Fig 4.13 A comparison of the average marks obtained by AHT (n=29) from Limpopo Province before and after a course on tick and worm control.

Two groups of AHT's were used (Figs 4.12 and Fig 4.13). The first group came from North West Province (n=15) and the second group from Limpopo Province (n=29). Three of the respondents from Limpopo Province left before they could undergo the second assessment and so only have marks for the first assessment. As in a test performed to assess student knowledge at a tertiary institution, 50% was taken as an acceptable mark. It may be noted that the average mark before the course for AHT from NWP was 35.64%, which was not acceptable. Only one respondent was above 50%, the range was from 1.82% to 54.55%. After the course the average mark improved significantly to 54.50%,

which was still low, however the single respondent who had a mark of 7.27%had a marked influence. The range was 7.27% to 82.93%. Five of the respondents were below 50% on the second test (Fig 4.12).

From Fig 4.13, it may be seen that the situation found with AHT's from Limpopo Province was similar. None of the AHT's passed with 50% or higher before the course and, although there was a significant improvement in the second evaluation, only 17 of the 26 who wrote the second test, passed. The average mark before the course was 27.50% (range 7.32-43.90%) and after the course was 49.72% (19.51-68.29%).

These results were rather surprising, considering that a large amount of the routine veterinary extension to farmers is about ticks and worm control. It was not anticipated that the base-line knowledge of AHT's would be so low; definitely this level of knowledge is unacceptable and should be addressed by the state veterinary services.

The course was supposed to be a refresher course and included the material required to do extension to the farmers in terms of this study. However the level of knowledge of the AHT's involved in the study was not considered to be adequate (although NWP was higher than Limpopo Province) and further in-service training was undertaken with the AHT's.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

At the end of this study the following conclusions we reached:

- The level of knowledge of AHT about the recognition of cattle parasites, disease caused and control was inadequate, despite their qualification, in service training and regular courses.
- Farmers chose the topic of extension (ticks and worms) and participated fully in the planning and execution of extension evaluation. This participatory method resulted in no dropouts, all 90 farmers stayed in the study for the entire period
- The knowledge about tick and worm recognition, disease caused and control measures increased significantly from phase 1 to phase 3.
- In the six months between the farmers day (phase 2) and the structured interview (phase 3) the level of knowledge decreased, in other words, short –term memory (straight after information day) was good, but long-term memory (6 months later) was less.
- The level of parasites (ticks and worms) in the indicator cattle was not significantly different.

5.1.1 Evaluation of AHT

Despite the fact that the AHTs did not have satisfactory knowledge about cattle parasite control, they also did not have adequate extension materials needed to conduct such extension. These two realities may adversely impact on the effectiveness of AHT extension campaigns.

5.1.2 Evaluation of farmer's knowledge

The results of Phase 1 interviews revealed that the farmers average age was 65 years and that their education level was below standard 6 on average.

The result of Phase 2 interviews shows that the farmers' level of knowledge increased after the farmers day. This was in line with the assertion of this study hypothesis that stated that Moretele cattle farmers do not have sufficient knowledge and skills to control ticks and internal worms in cattle and this could be improved by an effective state veterinary extension service delivery campaign.

The results of Phase 3 showed that farmers knowledge decreased significantly 6 months after the farmers day. However it was still significantly greater than the knowledge level taken as baseline in phase 1. This may be related to the advanced age of the farmers. It is also relevant to the perception that "extension to stock farmers does not work " – people need repletion of facts and the facts must be relevant to their interest, if they are to remember them. Ticks control is

obviously more important to this group of farmers than worm control (only 10 farmers dewormed cattle) and the recall on where to buy acaricides was significantly higher than the recall on where to buy anthelminthics.

The expectation that if an extension day held, the farmers will remember it forever is wrong perception and should be emphasized.

5.1.3 Evaluation of level of parasites

The increase in the knowledge of farmers did not make an appreciable difference to the levels of parasites in the cattle. Figures 4. 11, 12, 13, 14, and 15 shows a comparison of parasite levels between autumn of 2001 and 2002. The following are the possibilities for this scenario:

- The ticks and worms were at a low level due to resistance by the cattle
- The current (phase 1) level of control was reasonably effective (only low levels of ticks and worms were present) and farmers were not motivated to do more than they were already doing.
- Farmers did not apply the extension education and training that they had received due to issues such as age related inability to implement extension, availability or expense of stock remedies, lack of crush pens, forgetting to dose, expecting the state to do it for them, or animals being too wild.

5.2 Recommendations

5.2.1 Improvement of AHT service delivery

- At the beginning of this research study it was discovered that the

AHT did not have adequate knowledge. It is therefore recommended that state extension personnel be refreshed (through workshops and skills training sessions) frequently on core extension dynamics, subject matter extension, adult education and community development dynamics. There is a dire need to do more training for AHTs with effective, incentive related evaluation. Frequent assessment of their knowledge is important as they are already attending many courses. The courses / workshops attended by the AHTs should have an assessment attached rather than just being attendance courses and maybe linked to performance management, as it is suspected that they do not learn form only attending courses.

There must be an effective way of monitoring and evaluation of extension service delivery including extension planning, extension organization, and extension implementation.

"Effective Monitoring and Evaluation (M & E) is regarded as of the most important and effective instruments enabling an improvement of all current and future extension" (Duvel, 2002). Anandajayasekeram *et al.* (1996) and Duvel (2002) elaborate extensively on a number of alternative means of extension impact assessment.

Investigations should be done to determine whether the curriculum offered to AHT at tertiary level is sufficient for the job description and if they get enough information on livestock parasitology to meet the farmers needs for extension.

5.2.2 The enhancement of adoption and implementation of extension

- There must be participatory action planning of extension by veterinary personnel and farmers, guided by state policy or the departmental strategic plan of Provincial departments.
- Extension must be repeated at intervals to refresh farmers' memories, considering that they are not young and that their long-term memory is poor. Long term recall is linked to whether there is re – inforcement of extension messages even in young (Beibudge 1991). However there is scope in agriculture for the young, enthusiastic farmer and this group should be motivated to undertake cattle farming so that extension is not always being done with the elderly and retired part-time farmer.
- The change in parasite levels between phase 1 and phase 3 was not significant. This may be related to farmers having knowledge but not implementing that knowledge. The causes may be multifactorial and are beyond the scope of this study. However further research on this is strongly suggested.

CHAPTER 6

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CHAPTER 7

APPENDICES

Appendix 1 Phase 1 farmers interview questionnaire

Date:…… **A. Farmer particulars and contact details (confidential)** Name(s), Surname, and I D no: …….. Farm name and number: …….. 3. Farm geographic location (lat and long for GIS): (a) South:…… (b) East:…… 4. Physical Address: …….. …….. 5**.** Postal Address: …….. …….. 6. Phone \ Fax no: …….. ……..	(V) Denote variable 1 and it consist of the farmer's personal particulars. V1	Spread sheet column denoted as (C). C1-C3

7. On whose land are you farming?

Lease	Yes (1)	No (2)		V2	C4
Own	Yes (1)	No (2)		V3	C5
Communal	Yes (1)	No (2)		V4	C6

8. What is your participation in farming?

A full-time livestock commercial farmer	(1)	V5	C7
A part-time livestock commercial farmer	(2)		
A full-time livestock communal	(3)		
A part-time livestock communal	(4)		

9. What is your vision in farming?

To be a commercial cattle farmer	(1)	V6	C8
To retire from farming	(2)		
To change to crop farming	(3)		
Other	(4)		

10. Do you have any other commitment that interferes with farming?

Teacher	(1)	V7	C9
Policeman	(2)		
Headman	(3)		
Work at a firm	(4)		
Other e.g. Business man	(5)		

11. Who is involved in farming?

Myself	(1)	V8	C10
Son	(2)	V9	C11
Daughter	(3)	V10	C12
Wife	(4)	V11	C13
Parent	(5)	V12	C14
Grandparent	(6)	V13	C15
Friend	(7)	V14	C16
Hired helpers (employee)	(8)	V15	C17
Other e. g relative	(9)	V16	C18

B. Land particulars

1. AHT farm soil types classification according to Acocks &Taiton

Clay	(1)	V17	C19
Sandy	(2)	V18	C20
Loam	(3)	V19	C21
Sandy loam	(4)	V20	C22
Other	(5)	V21	C23

2. AHT vegetation type(s) classification according to Acocks and Taiton

Sweet veld	(1)	V22	C24
Sour veld	(2)	V23	C25
Mixed veld	(3)	V24	C26
Other	(4)	V25	C27

3. What is the size of your farmland? (number variable with a maximum of 4 digits)

	V26	C28-C31

4. How many camps are there? If not divided, please write zero e.g. in communal grazing

(10=maximum number)

	V27	C32-33

5. Where do you obtain water?

Type	**Score**	**Variable**	**Column**
River	(1)	V28	C34
Dam	(2)	V29	C35
Borehole	(3)	V30	C36
Tap	(4)	V31	C37
Buy water	(5)	V32	C38
Other	(6)	V33	C39

6. Do the water source(s) supply sufficient water throughout the year?

Yes	(1)	V34	C40
No	(2)		

C. Herd Particulars

1. What cattle farming system are you practicing?

Extensive beef farming	(1)	V35	C41
Intensive beef (pastures)	(2)		
Dairy	(3)		
Dual purpose	(4)		
Other	(5)		

2. What is your herd demographic picture in terms of numbers (Numeric variables with 3 digits in every (5) categories)

Breed	**Bulls**	**Oxen**	**Cows**	**Heifers**	**Calves**	**Column**
Afrikaner	V36	V37	V38	V39	V40	C42-C56
Brahman	V41	V42	V43	V44	V45	C57-C71
Brownswiss	V46	V47	V48	V49	V50	C72-C86
Simmentaler	V51	V52	V53	V54	V55	C87-C101
Nguni	V56	V57	V58	V59	V60	C102-C116
Crosses	V61	V62	V63	V64	V65	C117-C131
Other (specify)	V66	V67	V68	V69	V70	C132-C146
TOTAL						

3. Herd Health Programs

3.1.Dipping program:

3.1.1.Do you know cattle ticks that transmit diseases?

Yes	(1)	V71	C147
No	(2)		

If the answer is yes, please indicate the ticks and the diseases they transmit.

1=right and 2=wrong

Tick name	**The diseases it transmits**	**Column**
Boophilus decolouratus (Blue tick) V72 (1) or (2)	Redwater (Babesiosis) Anaplasmosis / Gallsiekte V73 (1) or (2)	C148-C149
Rhipicephalus appendiculatus (Brown ear tick) V74 (1) or (2)	Any of the following: ECF, Corridor disease, ear infections and injuries, Theileriosis (draaisiekte) V75 (1) or (2)	C150-C151
Rhipicephalus evertsii (Red legged tick) V76 (1) or (2)	High tick burdens and worry V77 (1) or (2)	C152-C153
Hyalomma spp (Bont legged tick, Striped legged tick) V78 (1) or (2)	Sweating sickness in calves Abscesses and loss of teats V79 (1) or (2)	C154-C155
Amblyomma spp (Bont tick, Heartwater tick) V80 (1) or (2)	Heartwater Abscesses Loss of teats in cows V81 (1) or (2)	C156-C157

3.1.2 Do you dip your cattle?

Yes	(1)	V82	C158
No	(2)		

If answer is no, give reasons?

No crush	(1)	V83	C159
Too expensive	(2)	V84	C160
Medicines (Dip) too far away – not accessible	(3)	V85	C161
Do not know about dipping	(4)	V86	C162
Forget to dip	(5)	V87	C163
The government must dip the cattle	(6)	V88	C164
Animals too wild, cannot handle them (stock theft)	(7)	V89	C165
Other	(8)	V90	C166

If answer is yes, give reasons?

To get rid of ticks	(1)	V91	C167
To prevent abscesses	(2)	V92	C168
To save the udders and teats	(3)	V93	C169
To prevent diseases	(4)	V94	C170
Other	(5)	V95	C171

3.1.3. Who is dipping your cattle?

Self	(1)	V96	C172
Wife	(2)	V97	C173
Children	(3)	V98	C174
Other relative or friend	(4)	V99	C175
Employee	(5)	V100	C176

3.1.4. How frequently is dipping conducted? (numerical variable)

Season	**Dipping interval (interval per months)**	**Variable**	**Column**
Winter (Dry season)		V101	177
Summer (wet season)		V102	178

3.1.5. What brand name of dip / acaricide do you use to dip your cattle?

Drastic deadline	(1)	V103	C179
Triatix	(2)	V104	C180
Home made mixture	(3)	V105	C181
Ivomectin (Dectomax) injection	(4)	V106	C182
Jeyes Fluid	(5)	V107	C183
Dazzel dip	(6)	V108	C184
Pouracide	(7)	V109	C185
Old motor car oil	(8)	V110	C186
Tick grease	(9)	V111	C187
Other (specify)	(10)	V112	C188-C189

3.1.6. What dipping method(s) do you use?

Plunge dip	(1)	V113	C190
Spray race	(2)	V114	C191
Hand spray	(3)	V115	C192
Hand dress	(4)	V116	C193
Pour on	(5)	V117	C194
Injection	(6)	V118	C195
Acaricide tags	(7)	V119	C196
Other	(8)	V120	C197

3.1.7 Are you satisfied about the tick control?

Yes,	(1)	V121	C198
No	(2)		
Don't know	(3)		

3.1.8 Where do you buy the dip(s)?

Moretele State Vet. Office	(1)	V122	C199
UP Onderstepoort Veterinary Hospital	(2)	V123	C200
UP Makapanstad Veterinary Clinic	(3)	V124	C201
Pienaarsriver farmers Co-op	(4)	V125	C202
Bonn Accord Farmers Co-op	(5)	V126	C203
Lion Bridge in Pretoria	(6)	V127	C204
Other	(7)	V128	C205

3.1.9 Do you know what tick resistance to dips is?

Yes	(1)	V129	C206
No	(2)		

If the answer is yes, please explain. 1= right and 2=wrong

The correct answer is: The ticks will not die after you have dipped the cattle because they are "resistant" to the effects of the dip	V130 (1) or (2)	C207

3.2. De-worming program

3.2.1.Do you know what cattle internal worms are?

Yes	(1)	V131	C208
No	(2)		

If the answer is Yes please describe the following; 1=right and 2=wrong.

Roundworms	These are small (short) or large (long) thin round worms that occur in the intestines of cattle (animals) (1) or (2)	V132	C209
Tapeworms	These are flat-segmented worms. The segments are seen in the faeces, mainly of calves. (1) or (2) Some tapeworms of humans can cause measles in cattle. This is dangerous if you eat the meat. (1) or (2)	V133	C210
Flukes	Flat, leaf shaped parasites found in the liver. Conical flukes are found in the rumen and are small, oval and red. (1) or (2)	V134	C211
Other-e. g Parafilaria	The worm that cause cattle skin to drip blood. A small roundworm that infects the skin of cattle. (1) or (2)	V135	C212

3.2.2. Do you know the damage caused by cattle internal worms?

Yes	(1)	V136	C213
No	(2)		

If the answer is yes, state what you know.

Emaciation, losing weight	(1)	V137	C214
Diarrhoea	(2)	V138	C215
Measles	(3)	V139	C216
Death	(4)	V140	C217
Bottle jaw	(5)	V141	C218
Anaemia (pale mucous membranes)	(6)	V142	C219
Poor hair coat	(7)	V143	C220
Weakness & depressed	(8)	V144	C221
Loss of milk in cows	(9)	V145	C222
Poor appetite	(10)	V146	C223-224

3.2.3. Do you de-worm your cattle?

Yes	(1)	V147	C225
No	(2)		

(i) If the answer is yes, please state reason(s).

To get rid of worms	(1)	V148	C226
To improve condition score	(2)	V149	C227
To prevent symptoms and deaths	(3)	V150	C228
Other (any other good reason or reasons)	(4)	V151	C229

(ii) If the answer is no, please state reason(s).

No crush	(1)	V152	C230
Too expensive	(2)	V153	C231
Medicines (De-wormer) too far away – not accessible	(3)	V154	C232
Do not know about de-worming	(4)	V155	C233
Forget to dose	(5)	V156	C234
The government must de-worm the cattle	(6)	V157	C235
Animals too wild, cannot handle them (stock theft)	(7)	V158	C236
Other	(8)	V159	C237

3.2.4 Who is dosing your cattle?

Self	(1)	V160	C238
Wife	(2)	V161	C239
Children	(3)	V162	C240
Other relative or friend	(4)	V163	C241
Employee	(5)	V164	C242

3.2.5. How frequently is dosing of cattle conducted? (numerical variable)

Season	Dosing interval (frequency per months)	Variable	Column
Winter (dry season)		V165	C243
Summer (wet season)		V166	C244

3.2.6. What type(s) of remedies do you use?

De-worming liquids	(1)	V167	C245
De-worming powders	(2)	V168	C246
De-worming injections	(3)	V169	C247
Home–made mixtures	(4)	V170	C248
Other	(5)	V171	C249

3.2.7. Where do you obtain the de-worming remedies?

Moretele State Vet. Office	(1)	V172	C250
UP. Onderstepoort Veterinary Hospital	(2)	V173	C251
UP. Makapanstad Veterinary Clinic	(3)	V174	C252
Pienaarsriver farmers co-operative	(4)	V175	C253
Bonn Accord Farmers Co-op	(5)	V176	C254
Lion Bridge in Pretoria	(6)	V177	C255
Other	(7)	V179	C256

3.2.8 Which de-worming method(s) do you use?

Dosing	(1)	V180	C257
Injection	(2)	V181	C258
Other	(3)	V182	C259

3.2.9 Do you know about worm resistance to anthelmintics?

Yes	(1)	V183	C260
No	(2)		

If the answer is Yes, please describe what “worm resistance to anthelminthics” means;

1=right and 2=wrong.

The worms do not die off after the animal has been dosed with a de-wormer (anthelmintic).	V184 (1) or (2)	C261

(D) Extension personnel's general remarks

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Appendix 2 Phase 2 farmers interview questionnaire

1. Herd Health Programs

1.1.Dipping program

1.1.1.Do you know cattle ticks that transmit diseases?

Yes	(1)	V1	C1
No	(2)		

If the answer is yes, please indicate the ticks and the diseases they transmit.

1=right and 2=wrong

Tick name	The diseases it transmits	Column
Boophilus decolouratus (Blue tick) V2 (1) or (2)	Redwater/ Babesiosis Anaplasmosis/ Gallsiekte V3 (1) or (2)	C2-C3
Rhipicephalus appendiculatus (Brown ear tick) V4 (1) or (2)	Any of the following: ECF, Corridor disease, ear infections and injuries, Theileriosis (draaisiekte) V5 (1) or (2)	C4-C5
Rhipicephalus evertsii (Red legged tick) V6 (1) or (2)	High tick burdens and worry V7 (1) or (2)	C6-C7
Hyalomma spp (Bont legged tick, Striped legged tick) V8 (1) or (2)	Sweating sickness in calves Abscesses and loss of teats V9 (1) or (2)	C8-C9
Amblyomma spp (Bont tick, Heartwater tick) V10 (1) or (2)	Heartwater Abscesses Loss of teats in cows V11 (1) or (2)	C10-C11

1.1.2 Is it necessary to dip your cattle?

Yes	(1)	V12	C12
No	(2)		

If answer is no, give reasons?

No crush	(1)	V13	C13
Too expensive	(2)	V14	C14
Medicines (Dip) too far away – not accessible	(3)	V15	C15
Do not know about dipping	(4)	V16	C16
Forget to dip	(5)	V17	C17
The government must dip the cattle	(6)	V18	C18
Animals too wild, cannot handle them (stock theft)	(7)	V19	C19
Other	(8)	V20	C20

If answer is yes, give reasons?

To get rid of ticks	(1)	V21	C21
To prevent abscesses	(2)	V22	C22
To save the udders and teats	(3)	V23	C23
To prevent diseases	(4)	V24	C24
Other	(5)	V25	C25

1.1.3. Who is to dip your cattle?

Self	(1)	V26	C26
Wife	(2)	V27	C27
Children	(3)	V28	C28
Other relative or friend	(4)	V29	C29
Employee	(5)	V30	C30

1.1.4. How frequently are you going to dip your cattle? (numerical variable)

Season	Dipping interval (interval per months)	Variable	Column
Winter (Dry season)		V31	C31
Summer (wet season)		V32	C32

1.1.5. State tick control remedies to be used in your cattle?

Drastic deadline	(1)	V33	C33
Triatix	(2)	V34	C34
Home made mixture	(3)	V35	C35
Ivomectin (Dectomax) injection	(4)	V36	C36
Jeyes Fluid	(5)	V37	C37
Dazzel dip	(6)	V38	C38
Pouracide	(7)	V39	C39
Old motor car oil	(8)	V40	C40
Tick grease	(9)	V41	C41
Other (specify)	(10)	V42	C42-C43

1.1.6. Which dipping method(s) do you know?

Plunge dip	(1)	V43	C44
Spray race	(2)	V44	C45
Hand spray	(3)	V45	C46
Hand dress	(4)	V46	C47
Pour on	(5)	V47	C48
Injection	(6)	V48	C49
Acaricide tags	(7)	V49	C50
Other	(8)	V50	C51

1.1.7 Where are stock remedies sold?

Moretele State Vet. Office	(1)	V51	C52
UP .Onderstepoort Veterinary Hospital	(2)	V52	C53
UP .Makapanstad Veterinary Clinic	(3)	V53	C54
Pienaarsriver farmers Co-op	(4)	V54	C55
Bonn Accord Farmers Co-op	(5)	V55	C56
Lion Bridge in Pretoria	(6)	V56	C57
Warmbath NTK	(7)	V57	C58
Other	(8)	V58	C59

1.1.8 Do you know what tick resistance to dips is?

Yes	(1)	V59	C60
No	(2)		

If the answer is yes, please explain. 1= right and 2=wrong

The correct answer is: The ticks will not die after you have dipped the cattle because they are “resistant” to the effects of the dip	V60 (1) or (2)	C61

1.2. De-worming program

1.2.1.Do you know what cattle internal worms are?

Yes	(1)	V61	C62
No	(2)		

If the answer is yes, please describe the following; 1=right and 2=wrong.

Roundworms	These are small (short) or large (long) thin round worms that occur in the intestines of cattle (animals) (1) or (2)	V62	C63
Tapeworms	These are flat-segmented worms. The segments are seen in the faeces, mainly of calves. Some tapeworms of humans can cause measles in cattle. This is dangerous if you eat the meat. (1) or (2)	V63	C64
Flukes	Flat, leaf shaped parasites found in the liver. Conical flukes are found in the rumen and are small, oval and red. (1) or (2)	V64	C65
Other-e. g Parafilaria	The worm that cause cattle skin to drip blood. A small roundworm that infects the skin of cattle. (1) or (2)	V65	C66

1.2.2. Do you know the damage caused by cattle internal worms?

Yes	(1)	V66	C67
No	(2)		

If the answer is yes, state what you know.

Emaciation, losing weight	(1)	V67	C68
Diarrhoea	(2)	V68	C69
Measles	(3)	V69	C70
Death	(4)	V70	C71
Bottle jaw	(5)	V71	C72
Anaemia (pale mucous membranes)	(6)	V72	C73
Poor hair coat	(7)	V73	C74
Weakness, depressed	(8)	V74	C75
Loss of milk in cows	(9)	V75	C76
Poor appetite	(10)	V76	C77-C78

1.2.3 Is there a need to treat your cattle for worms?

Yes	(1)	V77	C79
No	(2)		

(i) If the answer is yes, please state reason(s).

To get rid of worms	(1)	V78	C80
To improve condition score	(2)	V79	C81
To prevent symptoms and deaths	(3)	V80	C82
Other (any other good reason or reasons)	(4)	V81	C83

(ii) If the answer is no, please state reason(s).

No crush	(1)	V82	C84
Too expensive	(2)	V83	C85
Medicines (De-wormer) too far away – not accessible	(3)	V84	C86
Do not know about de-worming	(4)	V85	C87
Forget to dose	(5)	V86	C88
The government must de-worm the cattle	(6)	V87	C89
Animals too wild, cannot handle them (stock theft)	(7)	V88	C90
Other	(8)	V89	C91

1.2.4 Who is to treat your cattle for internal worms?

Self	(1)	V90	C92
Wife	(2)	V91	C93
Children	(3)	V92	C94
Other relative or friend	(4)	V93	C95
Employee	(5)	V94	C96

1.2.5 How frequently is cattle treatment for worms going to be conducted in your herd?

(numerical variable)

Season	Dosing interval (frequency per months)	Variable	Column
Winter (dry season)		V95	C97
Summer (wet season)		V96	C98

1.2.6 What type(s) of remedies are you going to use for treating cattle internal worms?

De-worming liquids	(1)	V97	C99
De-worming powders	(2)	V99	C100
De-worming injections	(3)	V100	C101
Home–made mixtures	(4)	V101	C102
Other	(5)	V102	C103

1.2.7 Where are livestock remedies sold?

Moretele State Vet. Office	(1)	V103	C104
UP. Onderstepoort Veterinary Hospital	(2)	V104	C105
UP. Makapanstad Veterinary Clinic	(3)	V105	C106
Pienaarsriver farmers co-operative	(4)	V106	C107
Bonn Accord Farmers Co-op	(5)	V107	C108
Lion Bridge in Pretoria	(6)	V108	C109
Warmbath farms	(7)	V109	C110
Other	(8)	V110	C111

1.2.8 Which worms' control method(s) do you know?

Dosing	(1)	V111	C112
Injection	(2)	V112	C113
Other	(3)	V113	C114

1.2.9 Do you know about worm resistance to anthelmintics?

Yes	(1)	V114	C115
No	(2)		

Please describe what "worm resistance to anthelminthics" means; 1=right and 2=wrong.

The worms do not die off after the animal has been dosed with a de-wormer (anthelmintic).	V115 (1) or (2)	C116

1.2.10 Farmer number

Number allocated to farmer	C117-119

(D) Extension officer's general remarks

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Appendix 3 Phase 3 farmers questionnaire

1. Herd Health Programs

1.1.Dipping program

1.1.1.Do you know cattle ticks that transmit diseases?

Yes	(1)	V1	C1
No	(2)		

If the answer is yes, please indicate the ticks and the diseases they transmit.

1=right and 2=wrong

Tick name	The diseases it transmits	Column
Boophilus decolouratus (Blue tick) V2 (1) or (2)	Redwater/ Babesiosis Anaplasmosis/ Gallsiekte V3 (1) or (2)	C2-C3
Rhipicephalus appendiculatus (Brown ear tick) V4 (1) or (2)	Any of the following: ECF, Corridor disease, ear infections and injuries, Theileriosis (draaisiekte) V5 (1) or (2)	C4-C5
Rhipicephalus evertsii (Red legged tick) V6 (1) or (2)	High tick burdens and worry V7 (1) or (2)	C6-C7
Hyalomma spp (Bont legged tick, Striped legged tick) V8 (1) or (2)	Sweating sickness in calves Abscesses and loss of teats V9 (1) or (2)	C8-C9
Amblyomma spp (Bont tick, Heartwater tick) V10 (1) or (2) (2)	Heartwater Abscesses Loss of teats in cows V11 (1) or (2)	C10-C11

1.1.2 Are you dipping your cattle?

Yes	(1)	V12	C12
No	(2)		

If answer is no, give reasons?

No crush	(1)	V13	C13
Too expensive	(2)	V14	C14
Medicines (Dip) too far away – not accessible	(3)	V15	C15
Do not know about dipping	(4)	V16	C16
Forget to dip	(5)	V17	C17
The government must dip the cattle	(6)	V18	C18
Animals too wild, cannot handle them (stock theft)	(7)	V19	C19
Other	(8)	V20	C20

If answer is yes, give reasons?

To get rid of ticks	(1)	V21	C21
To prevent abscesses	(2)	V22	C22
To save the udders and teats	(3)	V23	C23
To prevent diseases	(4)	V24	C24
Other	(5)	V25	C25

1.1.3. Who is dipping your cattle?

Self	(1)	V26	C26
Wife	(2)	V27	C27
Children	(3)	V28	C28
Other relative or friend	(4)	V29	C29
Employee	(5)	V30	C30

1.1.4. How frequent is dipping conducted in your cattle herd? (numerical variable)

Season	Dipping interval (interval per months)	Variable	Column
Winter (Dry season)		V31	C31
Summer (wet season)		V32	C32

1.1.5. State tick control remedies you have been using to treat your cattle for ticks?

Drastic deadline	(1)	V33	C33
Triatix	(2)	V34	C34
Home made mixture	(3)	V35	C35
Ivomectin (Dectomax) injection	(4)	V36	C36
Jeyes Fluid	(5)	V37	C37
Dazzel dip	(6)	V38	C38
Pouracide	(7)	V39	C39
Old motor car oil	(8)	V40	C40
Tick grease	(9)	V41	C41
Other (specify)	(10)	V42	C42-C43

1.1.6. Which dipping method(s) have you been using to dip your cattle?

Plunge dip	(1)	V43	C44
Spray race	(2)	V44	C45
Hand spray	(3)	V45	C46
Hand dress	(4)	V46	C47
Pour on	(5)	V47	C48
Injection	(6)	V48	C49
Acaricide tags	(7)	V49	C50
Other	(8)	V50	C51

1.1.7 Where do you buy stock remedies?

Moretele State Vet. Office	(1)	V51	C52
UP Onderstepoort Veterinary Hospital	(2)	V52	C53
UP Makapanstad Veterinary Clinic	(3)	V53	C54
Pienaarsriver farmers Co-op	(4)	V54	C55
Bonn Accord Farmers Co-op	(5)	V55	C56
Lion Bridge in Pretoria	(6)	V56	C57
Warmbath NTK	(7)	V57	C58
Other	(8)	V58	C59

1.1.8 Please explain what tick resistance to dip is?

Yes	(1)	V59	C60
No	(2)		

If the answer is yes, please explain. 1= right and 2=wrong

The correct answer is: The ticks will not die after you have dipped the cattle because they are “resistant” to the effects of the dip	V60	C61

1.2. De-worming program

1.2.1.Name and explain cattle internal worms are?

Yes	(1)	V61	C62
No	(2)		

If the answer is yes, please describe the following; 1=right and 2=wrong.

Roundworms	These are small (short) or large (long) thin round worms that occur in the intestines of cattle (animals) (1) or (2)	V62	C63
Tapeworms	These are flat-segmented worms. The segments are seen in the faeces, mainly of calves. Some tapeworms of humans can cause measles in cattle. This is dangerous if you eat the meat. (1) or (2)	V63	C64
Flukes	Flat, leaf shaped parasites found in the liver. Conical flukes are found in the rumen and are small, oval and red. (1) or (2)	V64	C65
Other-e. g Parafilaria	The worm that cause cattle skin to drip blood. A small roundworm that infects the skin of cattle. (1) or (2)	V65	C66

1.2.2. Do you know the damage caused by cattle internal worms?

Yes	(1)	V66	C67
No	(2)		

If the answer is yes, state what you know.

Emaciation, losing weight	(1)	V67	C68
Diarrhoea	(2)	V68	C69
Measles	(3)	V69	C70
Death	(4)	V70	C71
Bottle jaw	(5)	V71	C72
Anaemia (pale mucous membranes)	(6)	V72	C73
Poor hair coat	(7)	V73	C74
Weakness, depressed	(8)	V74	C75
Loss of milk in cows	(9)	V75	C76
Poor appetite	(10)	V76	C77-C78

1.2.3 Do you treat your cattle for worms?

Yes	(1)	V77	C79
No	(2)		

(i) If the answer is yes, please state reasons.

To get rid of worms	(1)	V78	C80
To improve condition score	(2)	V79	C81
To prevent symptoms and deaths	(3)	V80	C82
Other (any other good reason or reasons)	(4)	V81	C83

(ii) If the answer is No, please state reasons.

No crush	(1)	V82	C84
Too expensive	(2)	V83	C85
Medicines (De-wormer) too far away – not accessible	(3)	V84	C86
Do not know about de-worming	(4)	V85	C87
Forget to dose	(5)	V86	C88
The government must de-worm the cattle	(6)	V87	C89
Animals too wild, cannot handle them (stock theft)	(7)	V88	C90
Other	(8)	V89	C91

1.2.4 Who is treating your cattle for internal worms?

Self	(1)	V90	C92
Wife	(2)	V91	C93
Children	(3)	V92	C94
Other relative or friend	(4)	V93	C95
Employee	(5)	V94	C96

1.2.5 How frequent do you treat your cattle for worms? (numerical variable)

Season	Dosing interval (frequency per months)	Variable	Column
Winter (dry season)		V95	C97
Summer (wet season)		V96	C98

1.2.6 What type(s) of remedies are you using for treating cattle internal worms?

De-worming liquids	(1)	V97	C99
De-worming powders	(2)	V99	C100
De-worming injections	(3)	V100	C101
Home–made mixtures	(4)	V101	C102
Other	(5)	V102	C103

1.2.7 Where do you buy cattle remedies?

Moretele State Vet. Office	(1)	V103	C104
UP. Onderstepoort Veterinary Hospital	(2)	V104	C105
UP. Makapanstad Veterinary Clinic	(3)	V105	C106
Pienaarsriver farmers co-operative	(4)	V106	C107
Bonn Accord Farmers Co-op	(5)	V107	C108
Lion Bridge in Pretoria	(6)	V108	C109
Warmbath farms	(7)	V109	C110
Other	(8)	V110	C111

1.2.8 What worms' control method(s) are you currently using?

Dosing	(1)	V111	C112
Injection	(2)	V112	C113
Other	(3)	V113	C114

1.2.9 Explain what worm resistance to anthelmintics is?

Yes	(1)	V114	C115
No	(2)		

Please describe what “worm resistance to anthelminthics” means; 1=right and 2=wrong.

The worms do not die off after the animal has been dosed with a de-wormer (anthelmintic).	V115 (1) or (2)	C116

1.2.10 Are you satisfied about your cattle herd’s worms and tick control?

Yes	C117
No	

If the answer is no, please state reasons

Animals are too wild to handle	V116	C118
Worm and tick control remedies are lacking at the wholesalers	V117	C119
I forget	V118	C120
The remedies we buy do not work	V119	C121
Other	V120	C122

1.2.11 Farmer number

Number allocated to farmer	C123-125

(D) Extension officer's general remarks

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Appendix 4 Sample labels

Labels for respondents' cattle ticks and worms sampling

CATTLE TICK SURVEY RECORD

Farmer's name	
Farm name	
Commercial or Communal farming	
Date of sample collection	
Sample collector's/submitter's name	
Tick-borne disease(s) clinical signs	

CATTLE TICK SURVEY RECORD

TICK NAME	**1ST ANIMAL**	**2ND ANIMAL**	**3RD ANIMAL**	**4TH ANIMAL**	**5TH ANIMAL**
Boophilus decolaratus					
Amblyomma hebraeum					
Hyalomma trancutum					
Rhipicephalus appendiculatus					
Rhipicephalus evertsii evertsii					
TOTAL					
BURDEN					

CATTLE INTERNAL WORMS SURVEY RECORD

Farmer's name	
Farm name	
Commercial or Communal farming	
Date of sample collection	
Sample collector's/submitter's name	
Average herd body condition score	
Verminosis related clinical signs	

CATTLE INTERNAL WORMS SURVEY RECORD

WORM NAME	**WORMS EGGS PER GRAM**	**FARMER (HERD) NUMBER**
Roundworms		
Tapeworms		
Flukes		
BURDEN		

Appendix 5 Questionnaire to evaluate AHT

Cattle ticks

1. Identify the following cattle ticks species (see slides) (5 marks)

1.1_____

1.2_____

1.3_____

1.4_____

1.5_____

2. Give the common names of the following ticks and indicate if it is a 1-host, 2-host, or 3-host tick (10 marks)

Scientific name	Common name	No. of Host
Amblyomma		
Boophilus decoloratus		
Hyalomma trancutum		
Rhipicephalus Appendiculatus		
Rhipicephalus evertsi evertsi		

3. Draw the life cycle of a two –host tick (6)

4. Name the four ingredients of acaricides (ticks dips) registered for use on cattle in South Africa (4 marks)

_____

_____

5. Name the tick species that cause or transmit the following disease (7 marks)

Disease/Disorder	**Tick species that cause or transmit it**
Heartwater	
Redwater	
Anaplasmosis	
Sweating sickness	
Udder damage	
Corridor disease	
Abscesses	

6. Describe the following concept: “cattle-endemic stability situation” (4 marks)

_____

Cattle internal worms

1. Identify the worms in the following bottles (mounted modules) (8 marks)

Bottle Labeled 1		Bottle Labeled 5	
Bottle Labeled 2		Bottle Labeled 6	
Bottle Labeled 3		Bottle Labeled 7	
Bottle Labeled 4		Bottle Labeled 8	

2. Draw the lifecycle of a Liver Fluke in cattle (5 marks)

3. What is the name of “measles” causing in cattle and how is measles diagnosed in cattle (4 marks)

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4. Give the names of 4 ingredients of anthelmintics (4 marks)

_____

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5. Define worm ‘resistance’ (3 marks)

TOTAL MARKS = 60